April 16, 1956 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Forging DEW Line: Security From North

•

Transatlantic Lines Aim for New High

TWA Super G Constellation

First in Constant Speed Drives...

SUNDSTRAND

DC-8 advanced electrical system design made possible by Sundstrand Constant Speed Drives

Douglas engineers are going all out to make the DC-8 the best jet airliner modern technology can produce. They have incorporated advanced thinking in the electrical system design—a constant frequency Sundstrand-driven system that is automatic, paralleled, able to supply plenty of stable power under all flight conditions, and having heavy overload capacity. Necessary capacity is gained with less weight, easier utilization, assured reliability, and low cost of operation. The DC-8 will prove again how advanced design in electrical systems . . . made possible by the Sundstrand Constant Speed Drive . . . meets the challenge of today's . . . and tomorrow's . . . fast, high-flying jets.

New Electrical Horizons . . .

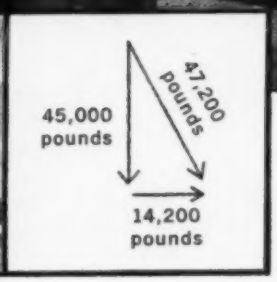
are opening to design engineers, through co-operation between engine and airframe manufacturers and Sundstrand. With this advanced design in electrical systems, expect remarkable advances in operation and performance of tomorrow's aircraft.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, ROCKFORD, ILLINOIS Western District Office: Hawthorne, California

CONSTANT SPEED DRIVES · AIRCRAFT ACCESSORIES

THIS IS A "CARRIER LANDING"



An example of how Goodyear's huge investment in tire-test equipment and research is paying off in greater aircraft landing safety

Here is a picture of a "carrier landing"—simulated in one of Goodyear's airplane tire-test laboratories. In this case, they are studying the effects of 45,000-pound radial loading and a 14,200-pound side loading—giving a resulting 47,200 tire-loading such as might occur when a carrier-based plane touches down with one wing up 17° from horizontal norm on a small 24" diameter tire.

To make the test tougher, and even more precise—a one-and-three-eighths-inch bar is laid across the loading platform to duplicate actual landing conditions where a tire smacks across an arresting cable. In addition, the tires, in order to resist "bottoming," are required to contain pressures ranging up to 350 pounds per square inch.

This serves to demonstrate a point.

Through this kind of exhaustive testing, both in laboratory and field—with extensive investments in test equipment—Goodyear earns and maintains a world-wide leadership not only in tire-building but in the engineering of wheels and brakes as well.

This leadership is clearly defined.

More airplanes land on Goodyear Tires, Wheels and Brakes than on any other kind!

Goodyear, Aviation Products Division,
Akron 16, Ohio, and Los Angeles 54, California

GOODYEAR
AVIATION
PRODUCTS

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

from any point of view...

Weber is the choice in passenger seats

decorator styling. It will become a habit for your passengers to express delight when they step into a Weber-appointed plane, where even the most discerning can settle back on rich upholstery . . . for a comfortable flight . . . in the most attractive surroundings. After our engineers had built in comfort, safety and strength, our design staff applied their experience and taste to the finest materials available . . . integrated satin-finished anodized aluminum, gleaming chrome, luxurious fabrics and handsome plastics . . . wove them together for a perfect blending of color, texture, contour and form. Airline passengers demand the finest. We, at Weber, are dedicated to the satisfaction of that demand. Styling, and other features of Weber passenger seats, are fully illustrated and described in a handsome new brochure. Write for one today.

WEBER AIRCRAFT CORPORATION

2820 Ontario Street, Burbank, California

AVIATION CALENDAR

Apr. 18-19—First Annual National Industrial Research Conference, Armour Research Foundation, Hotel Sherman, Chicago.

Apr. 19—Advertising Subcommittee of the Air Transport Association, Key Biscayne Hotel, Miami.

Apr. 19-20—Annual Meeting of the Science Section of the Environment Equipment Institute, Sheraton Hotel, Chicago.

Apr. 19-21—International Airlines Navigators Council, annual conference, Picadilly Hotel, New York.

Apr. 22-25—American Association of Airport Executives, 29th annual convention, Hotel Carter, Cleveland, Ohio.

Apr. 26—Institute of Navigation, annual regional meeting, Friendship International Airport, Baltimore, Md.

Apr. 26-27—Aeronautical Training Society, annual meeting, Mayflower Hotel, Washington, D. C.

Apr. 26-27—11th Annual Management Engineering Conference, Society for Advancement of Management-American Society of Mechanical Engineers, Hotel Statler, New York.

Apr. 26-27—Institute of the Aeronautical Sciences Southeastern Student Conference, Georgia Institute of Technology, Atlanta. **May 3-4**—Sixth Annual West Coast Student Conference, Los Angeles.

Apr. 30-May 4—Society of Aeronautical Weight Engineers, 15th national conference, El Cortez Hotel, San Diego.

May 1-3—Annual Electronics Components Symposium, Dept. of Interior Auditorium, Wash., D. C., sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, Radio-Electronic-Television Manufacturers Assn. and West Coast Electronic Manufacturers Assn.

May 2-3—Air Traffic Conference of the Air Transport Assn., spring meeting, Hotel Radisson, Minneapolis, Minn.

May 2-5—Twelfth Annual National Forum of the American Helicopter Society, Sheraton Park Hotel, Wash., D. C.

May 6-9—Second Annual Symposium on Flight Test Instrumentation, sponsored by Instrument Society of America, Bell Aircraft Corp., Convair and Temco Aircraft Corp., Hotel Texas, Fort Worth.

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TO YOUR SPECIFICATIONS

—from a famous precision manufacturer

At Ex-Cell-O you'll find a rare combination of engineering skill, trained workers, and huge departments of up-to-the-minute precision machinery. There's a special Engineering Staff to plan the economical way to produce your part or assemblies including machining, heat treating, and unit assembly. Rigid inspection methods safeguard Ex-Cell-O's reputation for precision work.

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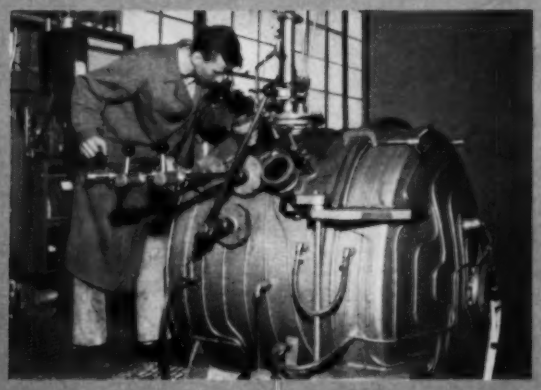
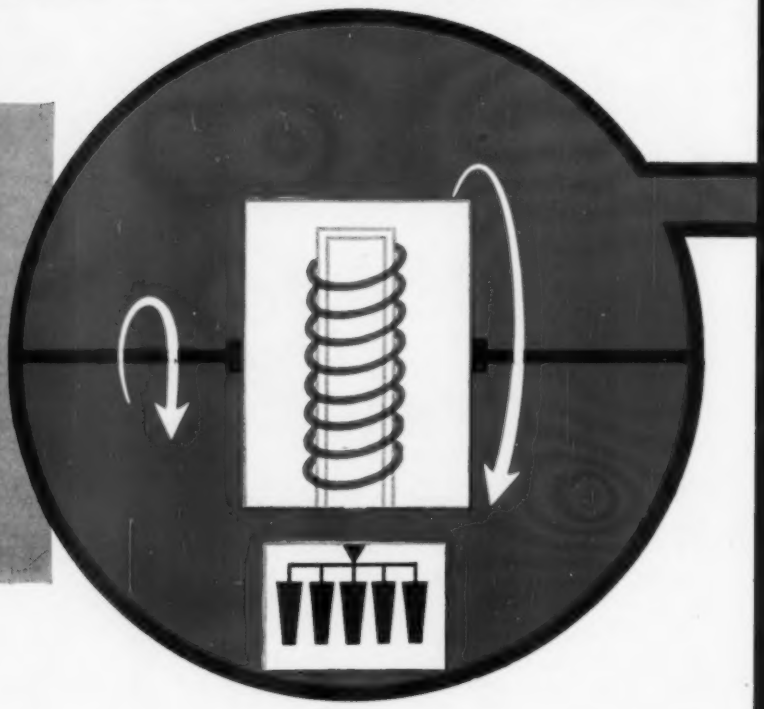
design with austenal in mind





New **VACUUM MELTING** *techniques being developed by* **MICROCAST** *give promise of higher performance parts for the future*

Austenal vacuum melting and casting techniques being currently developed may have a big place in your future designs.

Vacuum melting promises greatly improved investment castings and a wider range of cast parts, because it makes available alloys with outstanding high temperature properties. By removing harmful gases and holding down objectionable oxide inclusions, vacuum melting results in parts that are more ductile, stronger and tougher than before. Vacuum melting makes possible the use of alloys that were formerly uncastable.

For instance, these new Austenal techniques are already being studied for aircraft manufacturers on a development basis. Vacuum melting has helped furnish extremely high quality vanes and blades for future jet engines.

Discuss this new Austenal development with your Austenal representative. Vacuum melting may be the way for you to obtain higher performance in designing parts for tough jobs of the future.

---It's **NEW** *from Austenal*

Vacuum casting of turbine buckets such as this has been accomplished and the application of this method is being planned for other jet engine components.

austenal

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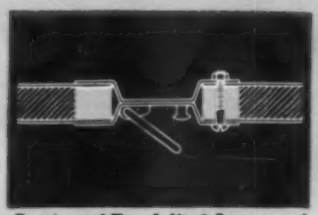
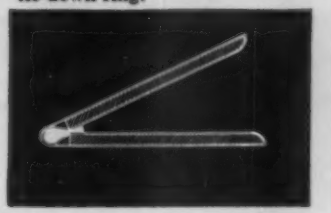
How many riveting and welding operations can you eliminate with

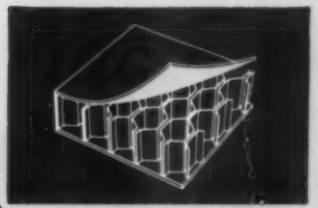
SOLVENT-FREE



Section of Bondolite® floor panel (®T. M. Goodyear Aircraft Corporation) with inserted cargo tie-down ring.



Wing flap section made from Bondolite. Bend is reinforced with Epon Adhesive VI.



Bondolite honeycomb construction. Epon Adhesive VI bonds aluminum skin to central aluminum honeycomb.

EPON® ADHESIVES?

New Epon adhesives are being specified to replace expensive riveting and welding in an ever-increasing variety of aircraft applications. Because they contain no solvents, Epon adhesives permit immediate assembly of metal-to-metal bonded parts. Contact pressure alone is all that is required to form sound bonds. Surfaces before bonding need not be machine-finished and glue lines need not be uniform. Air-relief drilling is never needed.

For your specific needs, three standard formulations are:

- **EPON ADHESIVE VI: General purpose, high-strength adhesive. Cures at room temperature or slightly above.**
- **EPON ADHESIVE VIII: High strength, capable of withstanding moderately high service temperatures. Cures in 90 minutes at 200°F.**
- **EPON ADHESIVE 422: A special formulation in tape form for service at temperatures up to 500°F.**

Epon adhesives have been used successfully in bonding metal, plastics, rubber and wood for helicopter rotor blades, honeycomb wing sections, jet fuel tanks, radar antennae, structural joints and floor panels. Can Epon adhesives solve an assembly problem for you? Write us about your problem and we'll send full technical information and samples.

(Epon resins are the epoxy polymers made exclusively by Shell Chemical Corporation)

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you SAVE with WEATHERHEAD Cored FORGINGS

ALUMINUM
BRASS
TITANIUM

This unretouched photo shows the flash on a conventional forging which necessitates close trimming and buffing to eliminate possible fatigue points where flash joins the forging body.

plus these advantages

- Die-casting accuracy—better finishes
- Long, deep cores—4 ways if desired
- Higher strength—dense, uniform grain structure
- No porosity—no flaws
- Less tooling—increased tool life
- Less machining time—reduced scrap

This unretouched photo shows a Weatherhead Cored Forging of the same part. Little or no flash provides superior grain structure throughout, and reduces the machining time to a bare minimum.

Amazing new production method increases life of a part as much as 200% over conventional methods!

A quick glance at the above photos shows the *material* difference between conventional forging and the Weatherhead Cored Forging. But that's only the beginning. Overall savings provide further proof that here, at last, is a method of producing *quality*, high strength forged parts never before attained.

Developed for and used extensively by the Air Force, Weatherhead cored forgings have withstood brutal high pressure impulse tests beyond expectations. Because of superior grain structure, cored forgings have reached an amazing 225,000 impulse cycles at 3000 psi! Want more facts? Just mail coupon.

Send for the facts

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(The Weatherhead Co. of Canada, Ltd.)

A NEW NWL *Lift* LINE...

HIGH TEMPERATURE ACTUATOR

NOW hydraulic actuators operating in areas of . . .

. . . 800° F

It is now possible for you to incorporate the advantages of *hydraulics* in high temperature areas on jet engines and airframes. NWL design developments in the seals and internal configuration of the new Lift Line High Temperature Actuators are making possible such units as the pictured synchronous afterburner actuator.

SYNCHRONOUS ACTUATION . . .
. . . between two or more units is achieved through internal gearing and screw arrangements, inter-connected by flex shafting. Inter-positional relationship is maintained to thousandths of an inch. Adjustable stops, fail-safe locking, lightness of weight and selective intermediate positioning are features of this line.

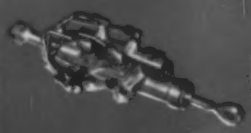
ACTUATOR SPECIFICATIONS . . .
Operating Pressure: 50 to 5,000 psi; *Temperature Range:* (ambient) —65° to 500° F., (extended rod) 800° F.+, (all) —65° to 400° F.; and *Rated Loads:* available to your specifications.

ADDITIONAL SPECIFICATIONS . . .
. . . and assistance in applying NWL engineering and quantity precision-production facilities and techniques to your high temperature problems, are available from local NWL sales-engineers and engineering project teams.

other new *Lift* line products . . .

ELECTRO-HYDRAULIC METERING VALVE
Electrical inputs — transformed to controlled hydraulic flow response . . . rate of response, repeatability and proportional accuracy is achieved. Developed for guided missile control systems.

UNICON
Manual, autopilot and flight stabilization modes of control are integrated in the NWL unified flight control actuator.



HIGH TEMPERATURE SERVO ACTUATOR
Servo control actuators for operation in excess of 300° F. have been qualified and are in production.

SERVO VALVE
Conserved hydraulic response vs. mechanical input servo valves are available for single or dual tandem system applications.

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DIVISION OF CLEVELAND PNEUMATIC TOOL COMPANY
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The *Lift* LINE

HIGH PERFORMANCE
PRESSURE SWITCHES

These recently developed aircraft pressure switches cover operating points within the entire range of inches of water through 3000 psi. Construction materials are compatible with operating media encountered in current and foreseeable aircraft applications. Design features permit all switches to meet or to exceed the requirements of MIL-E-5272A and other applicable performance specifications. The three illustrated here are widely adaptable for specific applications — demonstrate the high performance standards of our complete line.

Our long experience and extensive facilities for developing, manufacturing and testing pressure switches for modern aircraft can be helpful to you. Engineering counsel is at your service. Please direct your inquiry to our headquarters plant, Danbury, Connecticut.

Differential Pressure Switch, Type 6840

DIFFERENTIAL ADJUSTMENT RANGE: 10 to 50 inches of water. **RESET VALUE:** 1.5 inches of water. **EXTERNAL ADJUSTMENT:** Doubly locked. **TEMPERATURE RANGE:** Minus 65° F. to plus 165° F. **WORKING PRESSURE:** 5 psig maximum. **PROOF PRESSURE:** 10 psig without setpoint drift. **VIBRATION:** MIL-E-5272A Procedure 1. **OVER-ALL DIMENSIONS:** Height 4-3/16", Length 6⅛". **WEIGHT:** 1 lb. 10 ozs.

Pressure Actuated Switch, Type 6885

PRESSURE ADJUSTMENT RANGE: 0.25-4, 2-10, 10-50, 50-150, 150-500 psi. **ACCURACY OF SETTING UNDER ALL TEST CONDITIONS:** 0.5 psi at 5 psi setting; 4% at 50 psi setting; 3% at 100 psi setting. **EXTERNAL ADJUSTMENT:** Knurled nut doubly locked. **TEMPERATURE RANGE:** Minus 65° F. to plus 250° F. **PROOF PRESSURE:** 750 psi without setpoint drift. **VIBRATION:** Up to 2000 cps at 20g. Integral vibration isolation provided between mounting bracket and switch body (see illustration). **OVER-ALL DIMENSIONS:** Switch proper 2" diameter. Length 4⅜". Mounting bracket to suit application. **WEIGHT:** 9 ozs.

Hydraulic Pressure Switch, Type 6856

PRESSURE ADJUSTMENT RANGE: 500 to 3000 psi. **ACCURACY OF SETTING:** ±60 psi. **RESET VALUE:** Variable from 100 to 300 psi. **TEMPERATURE RANGE:** Minus 65° F. to plus 165° F. Models also available to plus 275° F. **PROOF PRESSURE:** 4500 psi without setpoint drift. **BURST PRESSURE:** 7500 psi. *VIBRATION: MIL-E-5272A Procedure I. **OVER-ALL DIMENSIONS:** Length 3-11/16". Diameter 1-3/16". **WEIGHT:** 4.5 ozs. Available with various electrical connectors and mounting provisions to suit application.

* This unit can be supplied in the Type 6885 envelope to meet vibration requirements up to 2000 cps at 20 g.

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OUR AIRCRAFT PRODUCTS INCLUDE: TURBOJET ENGINE TEMPERATURE CONTROL AMPLIFIERS • ELECTRONIC AMPLIFIERS PRESSURE SWITCHES FOR ROCKETS, JET ENGINE AND AIRFRAME APPLICATIONS • PRESSURE GAUGES THERMOCOUPLES • HYDRAULIC VALVES • JET ENGINE AFTERBURNER CONTROL SYSTEMS.

Ted Frystak is one of more than 100 Honeywell Field Service Engineers. Consultants, teachers, and engineers, these men live with the Honeywell precision control systems wherever they fly in all operating theaters of the Navy and Airforce. Their suggestions for new controls, new applications, new modifications help Honeywell meet the fast-changing demands of modern aviation.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL

Grumman technician installs compact, lightweight Joy Axivane Fan in Sub-Killer's heating assembly.

SUB-KILLER STALKS WITH JOY

GRUMMAN CHOOSES JOY AXIVANE FANS FOR S2F-1 SUB-KILLER

MOST FROM LEAST . . . Grumman's "nutshell" formula for selecting Joy Axivane Aircraft Fans: Vaneaxial design permitted compact IN-THE-DUCT installation for *least* space; and produced largest air-volume with *least* power consumption. Installation required the *least* in duct work and the *least* in electrical control assembly. Light-alloy magnesium and aluminum involved the *least* weight with the most vibration-resisting and shock-resisting strength.

FROM 20 CFM TO OVER 6000 CFM is the range of ratings of Joy Axivane Aircraft Fans . . . in weights from 10 ounces to 50 pounds. Joy Axivane Aircraft Fans are working, today, in Grumman, North American, Douglas, Martin, and Sikorsky Aircraft. You can put them to work in yours, too. For details write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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Consult a Joy Engineer

WSW A-5938-45

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WORLD'S LARGEST MANUFACTURER OF VANE-AXIAL FANS

which way* to measure jet engine performance?

KOLLSMAN PRESSURE RATIO THRUSTMETER
used on Convair's F-102 and McDonnell's F-101

thrustmeters

to indicate PRESSURE RATIO...to indicate DIFFERENTIAL PRESSURE

Actual photograph

KOLLSMAN is in production...

on components for BOTH TYPES—for Remote or Direct reading

For over a quarter century, Kollsman has been making precision pressure sensitive mechanisms using displacement type diaphragms. This diaphragm can be called the heart of a thrustmeter pressure indicating system.

Our long experience making displacement type diaphragms guarantees reliable thrustmeters.

Proven Kollsman displacement type diaphragms, when fitted with Kollsman Synchrotels, comprise the transmitters for remote indicating types. Thousands of Synchrotels are now in use in other applications equally demanding of accuracy and durability.

Tailor-made Thrustmeters can be supplied for any engine-airplane combination. Write for complete technical information.

TYPICAL SYSTEM OPERATIONAL DATA

1. Accuracy: .015 in 100% of readings at room temperature.
   .025 in 85% of readings at −55°C and +70°C.
   .035 in 15% of readings at −55°C and +70°C.
2. Altitude: No specific limitation.
3. Power: 115V, 400CPS, single phase, 18VA
4. Pressure Ratio Range: 1.2 to 3.4
5. Pressure Ranges (operating):
   Pt_2=2 to 50" Hg. Abs.
   Pt_7=2.4 to 100" Hg. Abs.
   Pt_7-Pt_2=0.4 to 70" Hg.
6. Temperature Range: −55°C to +120°C
7. Weights:
   Transmitter: 2.2 lbs.
   Indicator (including integral amplifier): 1.8 lb.
8. Response: Full Range in 7 seconds.

**The Pressure Ratio System has advantages for indicating optimum climb and cruise throttle setting, whereas the Pressure Differential System has a definite advantage at take-off.*

Kollsman activities cover these seven fields:

AIRCRAFT INSTRUMENTS • PRECISION CONTROLS
PRECISION COMPUTORS AND COMPONENTS • OPTICAL COMPONENTS AND SYSTEMS
RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT • MOTORS AND SYNCHROS
INSTRUMENTS FOR SIMULATED FLIGHT TRAINERS

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Ryan is a $30 million facility, superbly equipped for its job of serving the aircraft and engine industries and the military services. With 850,000 square feet of factory floor space, Ryan manufacturing includes "big" jobs like the huge Boeing KC-135 mid and aft fuselages and Douglas DC-8 jet engine pods and pylons. With the most modern machine tools for forming, welding, machining and heat treating, Ryan manufactures the exacting jet engine, afterburner, rocket and ramjet components which require surgeon-like skills and intimate knowledge of high temperature alloys.

Ryan is 4750 people, headed by a management that has demonstrated experience and vigor in achieving top performance in quality, delivery and low costs. Ryan's financial stability and sound growth are widely recognized. Ryan's skilled production people are specialists who draw upon a background that covers 33 years of the half-century of flight. There is no parallel to the Ryan combination of experience, facilities and proven performance in its fields.

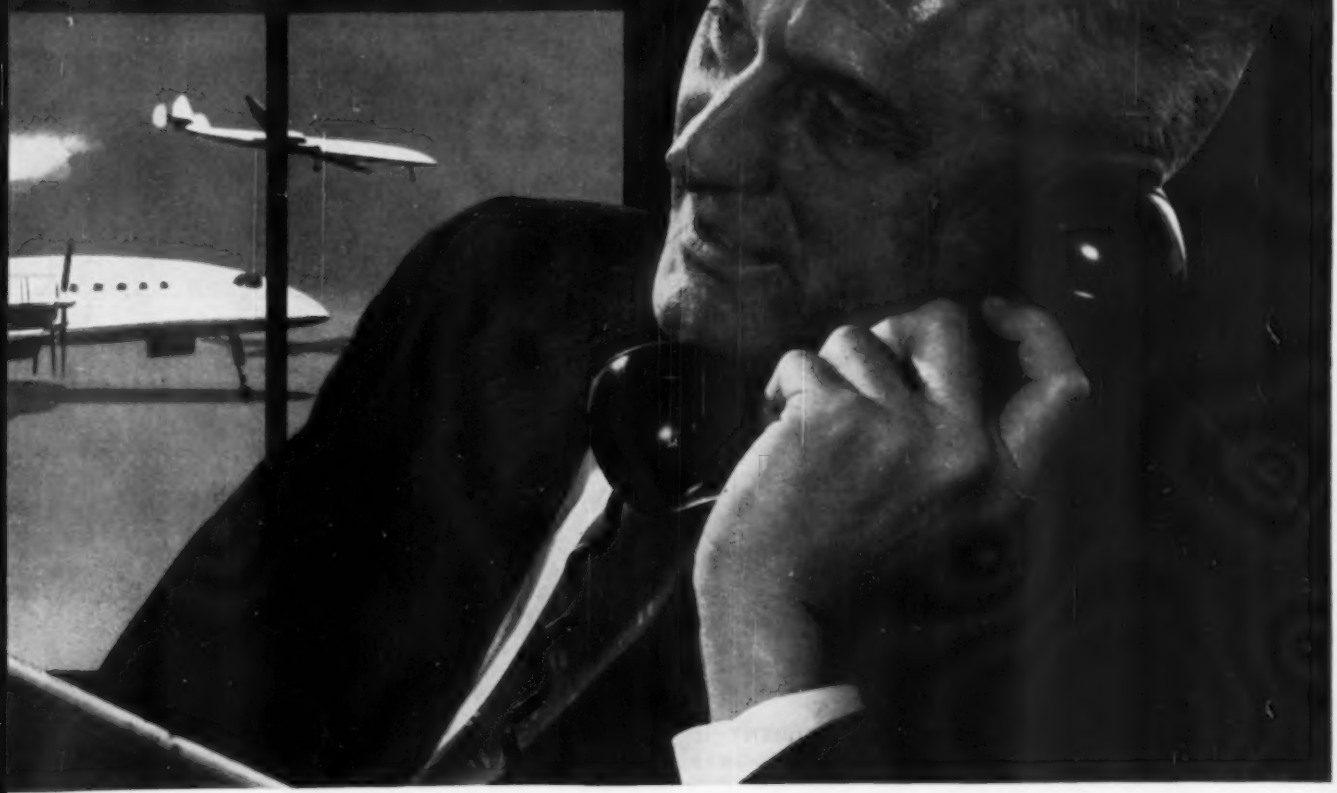
Ryan is a leader in research and development, which believes in "never letting well enough alone." One out of every six employees is in the engineering division. By enlightened attack upon aviation's complex problems, Ryan engineers are continually advancing the state of the art. Significant milestones in this steady progress are Ryan's all-jet VTO airplane, the world's first; the Firebee jet target drone and Ryan's unique electronic systems for automatic, global navigation and for missile guidance.

With a background of 33 years of experience in aviation, Ryan excels in designing and producing high quality aircraft, power plants and avionics, built at low cost, delivered on time.

Engineers looking for a challenging future will find outstanding opportunities at Ryan.

RYAN
AERONAUTICAL COMPANY
SAN DIEGO 12, CALIFORNIA

"For aviation cable that's safer, I call Packard Electric!"



Special insulation on Packard Aviation Cable has greater resistance to abrasion, fire, fuel and oil

PERFORMANCE is up and going higher on today's aircraft and in modern aircraft engines. Specifications are more exacting, right down the line. You'll be glad to know that Packard Cable is abreast of your requirements with special cable and insulation developments that offer greater resistance to abrasion, fire, spilled fuel, oil, hydraulic fluid, extremes of heat or cold, vibration fatigue, and other conditions that airborne equipment is exposed to.

PACKARD ELECTRIC is thoroughly indoctrinated in the uncompromising standards that have guided the aviation industry through its period of unparalleled progress and expansion. Our engineers have been solving cable problems for leading airframe and engine manufacturers since before World War I.

THIS KNOW-HOW, backed by the industry's most extensive research facilities, is your assurance of uniform high-quality cable, designed to the highest performance and safety specifications. And, Packard Electric's tremendous production capacity assures on-time delivery, and a price that is right.

GM GENERAL MOTORS

Packard

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Packard Electric Division
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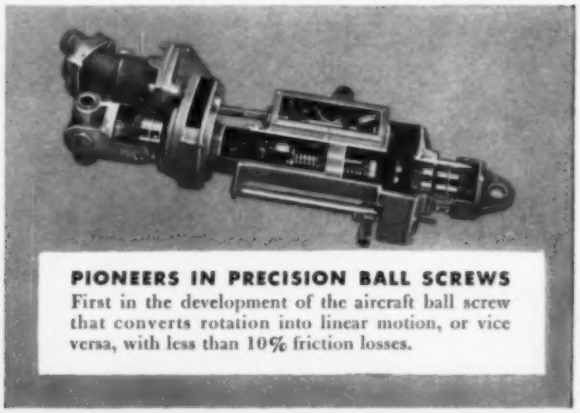
Offices in Detroit, Chicago, and Oakland, California • Aviation, Automotive and Appliance Wiring

CPT

Creative Pioneers in Transport

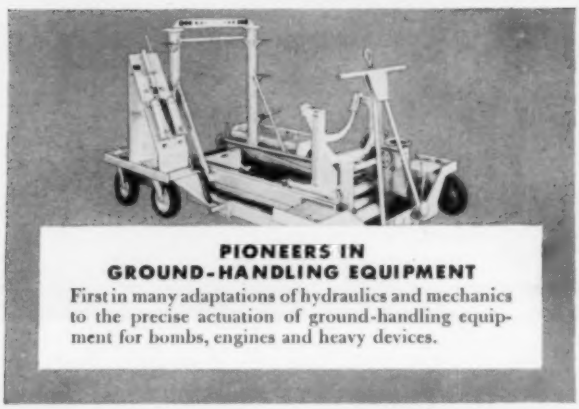
PIONEERS IN LANDING GEARS

First in the design, engineering, and production of landing gears for every type of airplane, helicopter, blimp, and missile.



PIONEERS IN PRECISION BALL SCREWS

First in the development of the aircraft ball screw that converts rotation into linear motion, or vice versa, with less than 10% friction losses.



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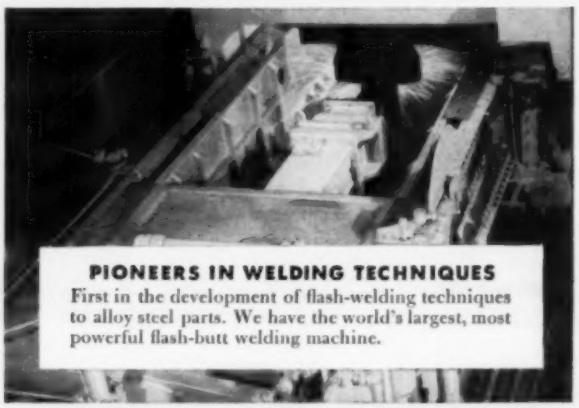

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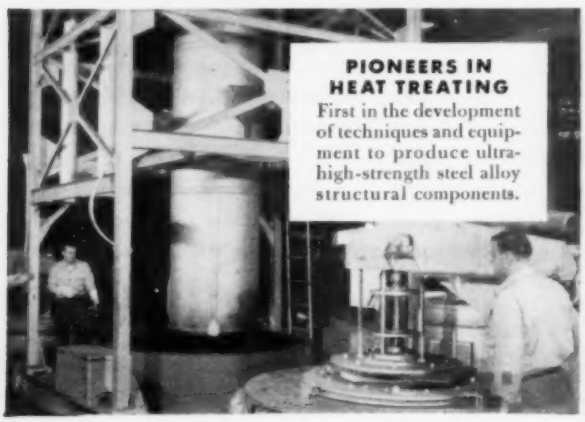

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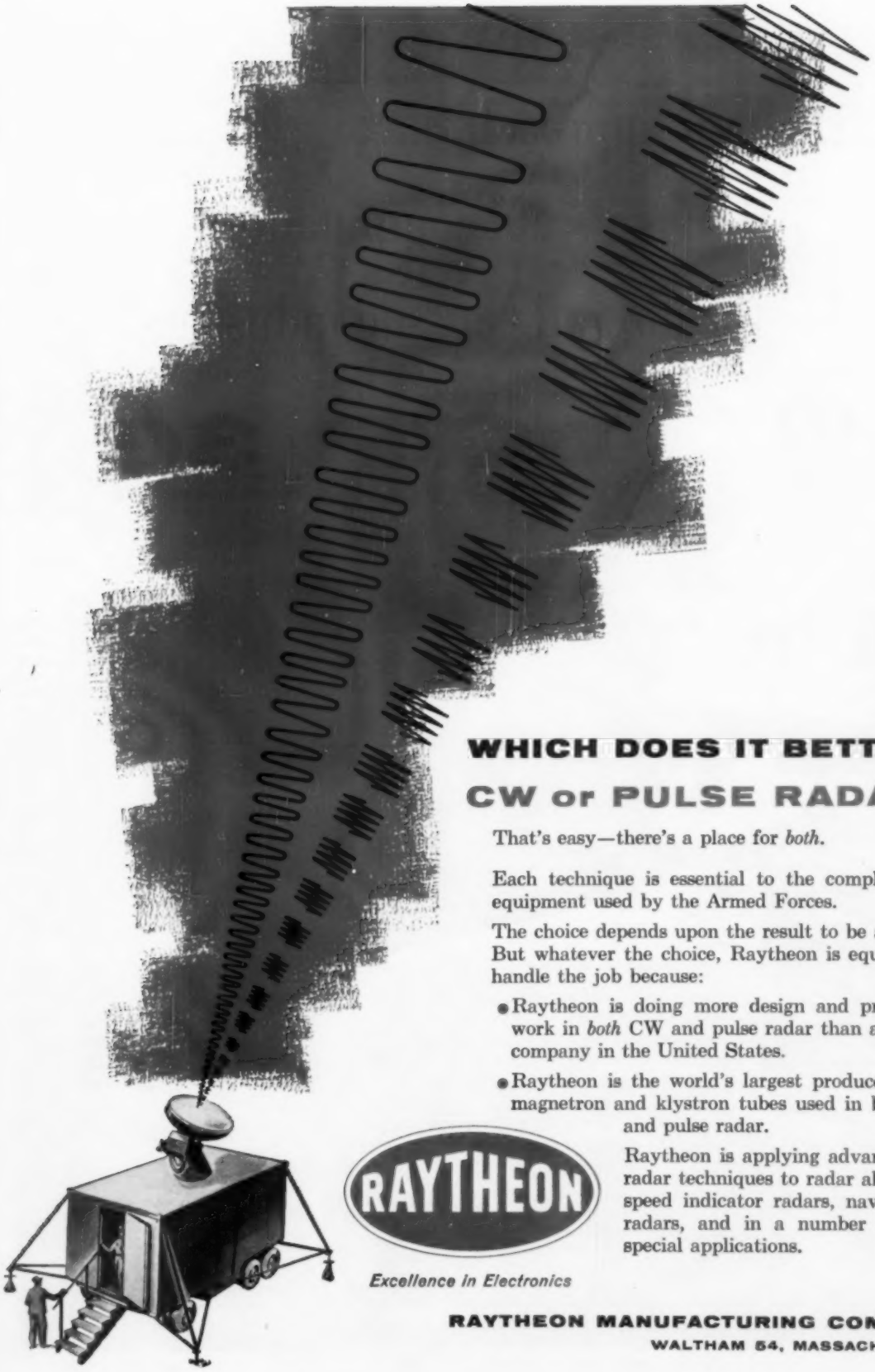

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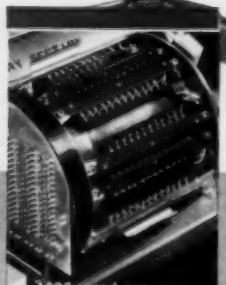

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APRIL 16, 1956

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RESEARCH AND MARKETING

Mary Whitney Fenton,
Elinore Eisenson, Joan Read

USAF Control Over Industry Charged 26
▶ Some manufacturers chafing under procurement rules; Quarles scheduled to hear complaints this week.

Arctic DEW Line Promises New Security 62
▶ Construction phase of Distant Early Warning System nears completion across 3,000 miles of arctic wasteland.

Transatlantic Travel to Reach New Peak 122
▶ A record 400,000 scheduled-flight passengers predicted for summer as airlines step up schedules.

MISSILE ENGINEERING

Northrop Snark in Flight 30
Sperry Sparrow 1 32
Is Missile Reliability Worth the Cost? 50
New Swedish Missile 59

AERONAUTICAL ENGINEERING

B-58 Engine Details Told to SAE 28
Flashlight: Swept-Wing Soviet Fighter 33
Army, Navy STOL Projects 34
Design Features of Frye Safari 39
Soviet Evolution: Badger to Tu-104 ... 46
USAF Hopes to Standardize Fasteners 55
Additions to Titanium Literature 59

SAFETY

British Report on Canadair Accident..103

EQUIPMENT

U.K. Direction Gyro Enters U.S. Market 57
Australia Develops New Rescue Vehicle 60
New Aviation Products 83
Also on the Market 85
What's New 90

BUSINESS FLYING

Colleges Help Solve Spray-Pilot Dearth 93
Private Lines 101

TRANSPORT

Viscount 700 Reaches 400 mph 41
Columbus Airport Increases Revenue.. 49
Airlines Set Stage for Jet Transports. 49
BOAC Gets San Francisco Route 123
Delta's Growth Potential 125
Mail Rates Reopened for 33 Lines 125
Tu-104 Interior: Jet-Age Damask 126
Mackey Planning New Routes, Merger.129
Airline-Fare Probe Urged 131
CJ805 Engine for Convair Jet 131
ACC Reveals National SAR Plan 132
CAB Orders 132

AVIONICS

Soviets Can Match U. S. Avionics 75
Avionic Expansions, Changes 77
New Avionic Products 78

MANAGEMENT

Lockheed, Convair A-plane Contracts.. 31
Delivery Delays Slow Navy Progress.. 32
President's Fund Plea Attacked 34
Two Vanguard Contracts Granted 45
House Group O.K.s Atom Plane R&D.. 45
Who's Where 23, 61
Industry Observer 23
Washington Roundup 25

Calendar 5
Letters 148

EDITORIAL

Who Is Running the Aircraft Industry?.. 21
Airpower Budget Boost 21

COVER: Trans World Airlines' Super G Constellation flies over lower tip of Manhattan Island on first leg of overseas flight. Transatlantic airlines expect a record season this summer with 400,000 passengers traveling on scheduled flights between North America and Europe. A detailed report on airline expectations and transatlantic travel trends appears on page 122.

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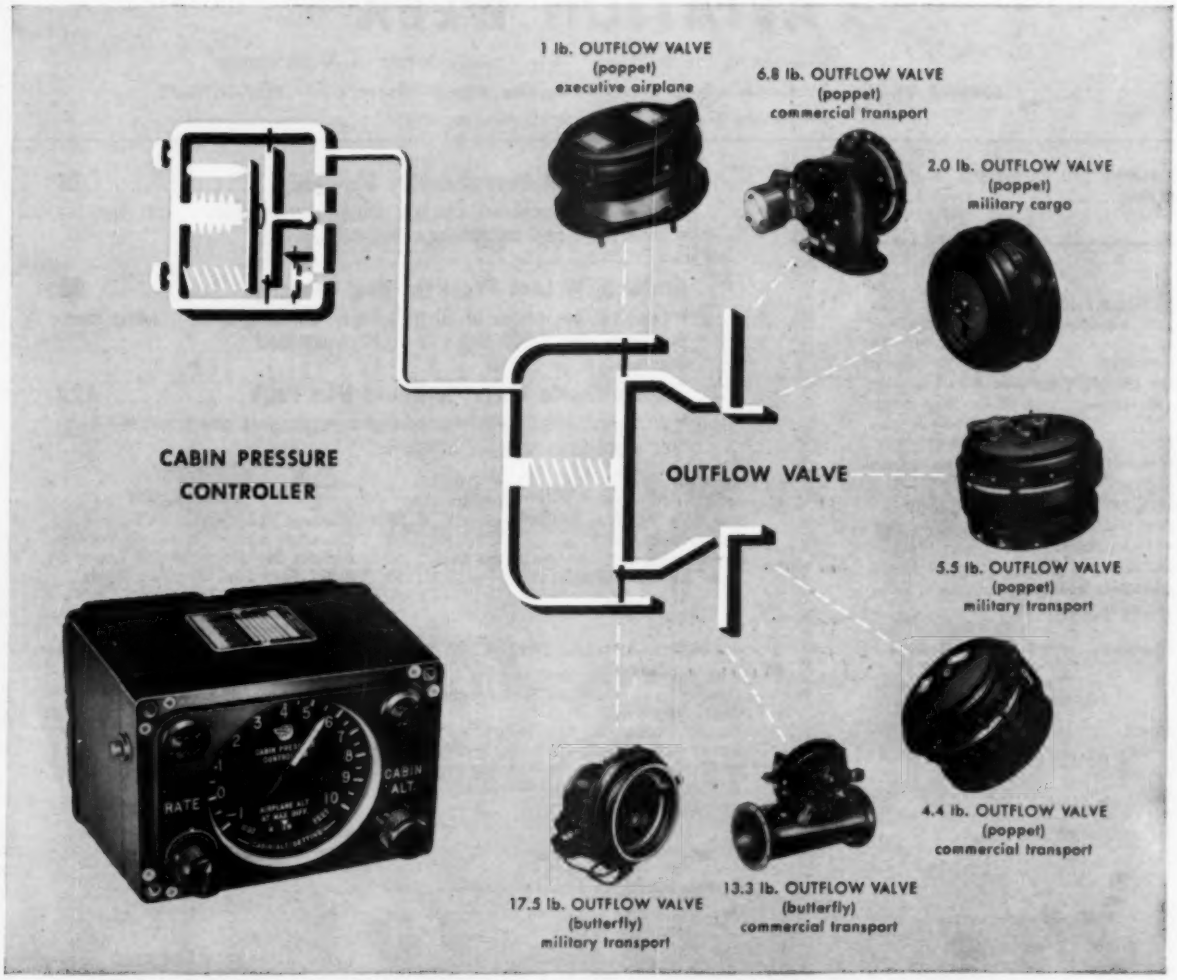

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EDITORIAL

Who Is Running the Aircraft Industry?

The Air Force and a major segment of the aircraft industry are scheduled for a head-on clash Wednesday in the office of USAF Secretary Quarles over major issues involving the exercise of management control. Only the bluntness of the clash is surprising to observers of the military aircraft procurement scene. The basic issues involved have been smouldering for some time with occasional flashes of fire on such issues as proprietary rights, subcontracting and profit margins.

There has been a growing feeling within the Air Force that it needs stronger safeguards to protect its interests in dealings with private industry on development and procurement of aerial weapon systems. At the same time USAF has recognized that it does not have, and probably never will have, the management talent required to be a successful weapon systems manager. This has generated policies to delegate more and more of the management functions to the men who operate private industrial firms. Running counter to this trend has been a policy of providing USAF contracting officers and plant representatives with more and more authority over the basic management policies of corporations attempting to do business with the military.

The basic problem involved is the necessity for maintaining the competitive drive and profit-inspired progress character of private industry while imposing effective safeguards to protect the Air Force and the taxpayer against fraud or poor performance.

There are some USAF officers who honestly believe they should "run" the aircraft industry down to the last rivet and who are personally galled when they compare their own modest military pay with the corporate salary scales. There are some aircraft industry managements who have a performance record on military business of which they can hardly be proud. But, somewhere in between these two extremes, the bulk of USAF officers and aircraft industry managements are honestly wrestling with the knotty problems of a sound, efficient and competitively driving military-industry relationship.

In considering these very real problems, it is necessary to look back at the sad record of the nationalized French aircraft industry in that country's hour of crisis before World War II and to study the current record of the British aircraft industry throttled by a maze of government controls in the Ministry of Supply. The trend toward more government control has always led to technical disaster in military aviation development and production.

USAF must have adequate protection against industry's failure to meet contract obligations, and the taxpayers must have protection against excessive costs for their military hardware. But the military-industry team now facing weapons-development and production problems of unprecedented complexity must operate on the basic principles of a private, competitive, profit-inspired system, not under the deadening influence of centralized government control.

Airpower Budget Boost

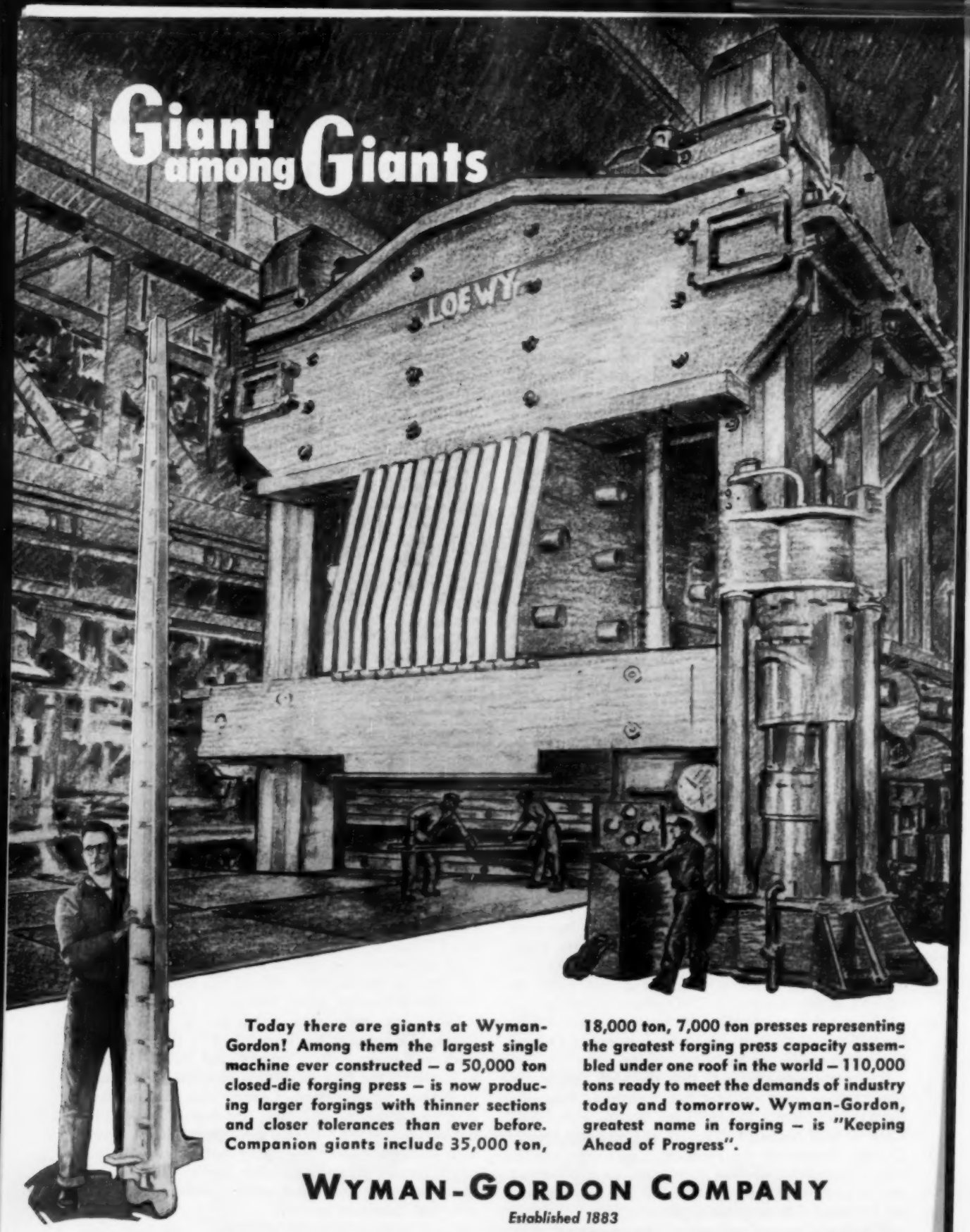
President Eisenhower's request to Congress last week for an additional $547 million to be added to the Fiscal 1957 airpower budget is incontrovertible proof that the original Defense Department budget is inadequate. In asking Congress to earmark $248 million of this sum for accelerated B-52 production, the President also confirms the validity of the criticism leveled at earlier Defense Department policy on this vital program.

It is encouraging to note that the $500 million airpower-budget boost was sent to Congress not long after the President had a White House session with USAF Chief of Staff Nathan F. Twining and Secretary Donald Quarles. Apparently the President is no longer satisfied with airpower information that filters to him through regular Defense Department channels and feels the need for first-hand data from his airpower experts.

Whether Congress will regard the President's $500 million boost as adequate to meet the real requirements of a 137-combat-wing program probably will depend in large measure on the information developed in the Senate airpower investigation opening this week under the direction of Senator Stuart Symington (D.-Mo.).

This is the second time in less than a year that the Defense Department has been forced by the twin pressures of Russian aviation progress and public criticism to accelerate the B-52 production program and increase its military airpower effort. Citizens who are depending upon superior airpower as their first line of defense cannot help wondering if there is something radically wrong with an airpower planning policy that reacts only after international competitors publicly display their achievements and only after the American public applies pressure that cannot be ignored.

—Robert Hotz



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G. R. Moore, vice president, Thompson Products, Inc., Cleveland, Ohio.

Robert H. Trench Thompson, appointed alternate director, British West Indian Airways. He is U. S. A. manager, British Overseas Airways Corp., and is to serve as alternate director to **Basil Smallpeice,** BOAC deputy chief executive, London.

Mark Kramer, assistant to president, Continental Air Lines.

E. A. Channer, vice president, H. M. Harper Co., Morton Grove, Ill.

George L. Rush, executive assistant for foreign operations, and **Peter T. Craven,** executive vice-president, Riddle Airlines.

Honors and Elections

Dr. Ernst Krause, director, Missile Systems Division, Lockheed Aircraft Corp., has received the Distinguished Civilian Service Award from the U. S. Navy for his achievements in rocket and nuclear weapons development.

Changes

D. B. Martin, sales director, Seattle Division, Boeing Airplane Co. Also: **Roger P. Holman,** plant facilities manager; **Elwood P. Kaiser,** quality control manager; **Howard W. Neffner,** contract administration director. In the Transport Division: **George R. Sanborn,** contract administration director; **Earle M. Pokela,** quality control manager and **Erle E. Barnes,** plant facilities manager. **A. A. Soderquist,** director, Seattle test unit of the Pilotless Aircraft Division's engineering department; **W. R. Owens,** project engineer, weapons support and equipment.

Dr. Erwin O. Naumann, chief of advanced studies, Engineering Division, Solar Aircraft Co., San Diego, Calif.

Walter L. Flinn, in charge of aircraft products application engineering offices, Vickers, Inc., in Washington, D. C.

John W. McGuyrt, manager, flight operations department, Chance Vought Aircraft, Inc., Dallas, Tex.

George M. Rouzee, sales manager, Sperry Gyroscope Co.'s Special Missile Systems Division, Great Neck, N. Y. Also: **Dr. Walter T. White,** engineering department head, missile weapon systems; **Byram A. Bunch** engineering section head, field test; **G. Kenneth Slaughter,** engineering department head, missile guidance; **J. R. Ericson,** engineering department head, missiles; **A. P. Gertz,** engineering department head, weapon systems applications.

(*Continued on page 61*)

INDUSTRY OBSERVER

► Lockheed has received a $15 million USAF order for a two-place version of the F-104. Carrying the designation F-104B, it will have combat capability as well as use as a trainer. The F-104A will be publicly unveiled tomorrow by Lockheed and USAF.

► **Douglas Aircraft Co. will use the Sperry SP-30 automatic flight control system in its DC-8 jet transports. The SP-30 employs transistors and magnetic amplifiers as a substitute for tubes and uses inertial-path damping, a new technique which, Sperry says, provides the tighter control required in jet-aircraft operation.**

► A new guidance system for the Rascal air-to-surface missile is being developed by the Federal Telecommunications Laboratory, Nutley, N. J., under a Bell Aircraft crash-program subcontract.

► **Anti-missile development contracts have been let to the Waltham Laboratory, Electronic Systems Division of Sylvania Electric Products Inc. One is a prime contract with the USAF, the other is a sub-contract to Convair's prime study.**

► Air Force estimates total cost of the SAGE program will be $1,086 million in capital items and annual operating cost will be $400 million. So far, $188 million has been spent on the program. House Armed Services Committee has approved legislation giving USAF clear authority to lease facilities from private telephone companies for operation of the system. It is estimated that the private leasing will amount to $240 million annually.

► **Fairchild J83 and General Electric J85 turbojets are rated in the 2,000 lb. thrust class and have thrust-weight ratios better than 10. Both engines are being considered as alternate powerplants for the Fairchild Airplane Division's long-range Goose missile.**

► Watch for announcement of a new entry in the small turbojet field with a thrust-weight ratio better than 12. Engine will be rated at 1,400 lb. sea level static thrust and will weigh 110 lb.

► **Although only one of the 11 R3Ys ordered from Convair by Navy has been delivered, remaining 10 are expected to be in service by December. Original target price for airframe contract was $100 million. The contract is being amended to cover a cost overrun of approximately 10%.**

► USAF overhauls Pratt & Whitney J57 engines after 325 hours. Navy estimates it will overhaul J57s after 165 hours. Difference is that USAF uses an earlier model for its high-altitude bombers, has more experience with it. Navy is using an afterburner model in fighter planes, which subjects engine to additional strain, and has limited operating experience with its model.

► **Navy has 58 basic models of aircraft in operation, compared to 72 in 1946. Even though basic number now is 58, Navy actually flies around 70 models. From postwar high, number of basic models dropped to 51 in 1949, then began a steady rise. By end of 1956 Navy estimates it will have only 67, predicts drop to 64 in 1957 and 63 in 1958.**

► New models of the twin-jet Douglas A3D Skywarrior attack-bomber include the A3D-2P (photo reconnaissance) and the A3D-2Q (radar countermeasures).

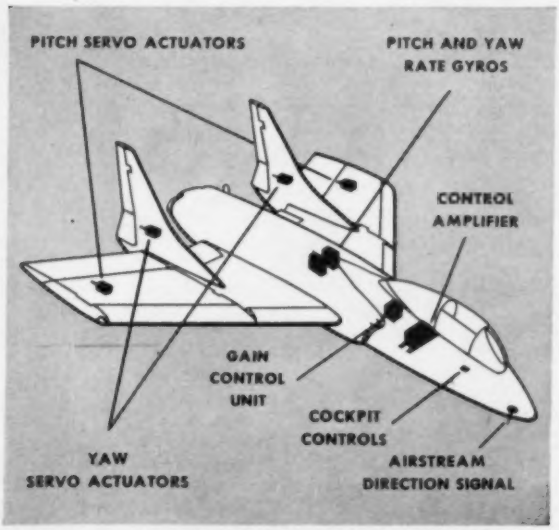
► **A multi-million-dollar order for the manufacture of constant speed drives for the Swedish Air Force SAAB J-35 double delta-wing interceptor has been received by Sundstrand Machine Tool Co., of Denver.**

► Navy is experimenting with the Vertol HUP-2 as a towing vehicle. Work is being done by mine countermeasures unit but does not involve minesweeping gear.

► **Air Force has awarded Marquardt Aircraft Co. a development contract for a 36-in.-diameter supersonic ramjet.**

CHANCE VOUGHT F7U-3 equipped with G-E flight stabilization system catapulted from carrier. (Official Photograph U.S. Navy)

How G-E flight stabilization system makes the Cutlass a stable gun platform



G-E FLIGHT STABILIZATION SYSTEM on the Chance Vought F7U-3 Cutlass damps yaw and pitch oscillations.

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Washington Roundup

Bilateral 'Inadequacies'

The Senate Commerce Subcommittee, headed by Sen. George Smathers (D.-Fla.), pins blame for the "inadequacies" of the U. S.-German bilateral air agreement on "the failure of the government to confer with and to allow sufficient participation by representatives of the airline industry." In the future, the subcommittee told the State Department, there should be full discussion between representatives of interested carriers and government representatives before there are any negotiations with foreign governments. Then a representative of the interested carriers should be made an accredited member of the U. S. delegation to negotiate the bilateral.

The subcommittee proposes that it should be continued as a watchdog group over bilateral negotiations.

'Explosion'

House Democrats are ready to make a major attack on the Administration and the Defense Department for failing to use—or for misusing—Defense funds voted by Congress. Rep. Daniel Flood (D.-Pa.), a member of the Military Appropriations Subcommittee, predicts "an explosion." Sen. Stuart Symington (D.-Mo.) already has charged that Defense dragged its feet on accelerating fighter programs of F-101s and F-104s, after obtaining the funds for it from Congress.

Flood complains that Defense Secretary Charles E. Wilson transferred funds voted to increase Marine strength to other activities, "including $250,000 to his own office. And he did this without Presidential approval, without the approval of the Defense Department counsel, and without the approval of the Department of Justice," Flood said.

Technician Shortage

Growing concern over the shortage of scientists and engineers has resulted in a resolution to establish a 16-man Joint House-Senate Committee on Scientific Research to "meet the problem of training adequate manpower in the scientific and technological fields." It was introduced by Sen. Edward J. Thye (R.-Minn.).

It follows two recent steps by President Eisenhower:

- **In the civilian field,** appointment of a national Committee for the Development of Scientists and Engineers, headed by Dr. Howard Landis Bevis, president of Ohio State University.
- **In the military field,** a letter to Congress urging enactment of "fringe benefits" legislation to attract more career servicemen. With it the President sent a letter from Defense Secretary Charles E. Wilson which noted that overall re-enlistment rate for enlistees in Fiscal 1955 was 15.7% compared to 6.9% for first term electronic technicians: 13.2% for aircraft maintenance technicians; 12.9% for communications technicians and 8.1% for armament technicians.

Durfee Appointment

Senate Commerce Committee unanimously voted confirmation of the nomination of James R. Durfee, 58, to the Civil Aeronautics Board after a 20-minute hearing. He will fill the Republican post, now held by Ross Rizley, for the term expiring Dec. 31, 1960, and is expected to be named chairman.

Durfee reported that he has had "no experience in aviation business or in airline regulation." In a cursory examination of the 1938 Civil Aeronautics Act after his recent nomination, Durfee said, he was notably impressed with the emphasis on "encouragement and development" of air transportation.

He is an attorney and has served as chairman of the Wisconsin Public Service Commission since 1953. Both Wisconsin Republican Senators—Alexander Wiley and Joseph McCarthy—favor his appointment.

Navy Missiles

Navy's efforts in development and evaluation of guided missiles brought these statements before a House Appropriations Subcommittee:

Assistant Secretary for Air James H. Smith, Jr. said the work is "beginning to bear fruit." He said he had just witnessed "one of these missiles in a very successful operation" with the Atlantic fleet, and what he saw "clearly demonstrated the overall progress we have made." The missile, he said, is "now being integrated into a complete, mobile, ship-based weapon system and are ready for sustained combat use." He undoubtedly referred to the Terrier.

Rear Admiral Frederic S. Withington, Chief of the Bureau of Ordnance, said quantity production of guided missiles "is very difficult to achieve. We have achieved it for the first time in a moderate sense with the Terrier missile in the Convair plant. This required a great deal of anguish and we at one time thought we would have to fire the contractor and look for another one. The cost of shipboard guided missile equipment is dreadfully high and it concerns me very deeply."

Admiral Withington also said the Navy is $1 billion short of the amount of ammunition needed for an all-out war. In some items Navy has "a full mobilization supply," he said, but "in antiaircraft and aircraft ammunition we do not." Rather than fill the ammunition gap Navy is taking "a calculated risk" and investing in newer weapons, particularly missiles, the testimony revealed.

Minetti, Lowen

The outlook now is that there will be action soon on the nominations of G. Joseph Minetti to the Civil Aeronautics Board and Charles J. Lowen to be Civil Aeronautics Administrator. The nominations have been sleeping in the Senate Commerce Committee since Jan. 9—while Sen. Mike Monroney (D.-Okla.), Chairman of the Aviation Subcommittee, made an investigation of the ouster of former Civil Aeronautics Administrator Fred Lee and considered legislation divorcing CAA from Commerce Department.

At a public session, Sen. Frederick Payne (R.-Me.) protested that the nominations have been held up "on the completely unsubstantiated charge that the Department of Commerce is ground-minded." Sen. John Pastore (D.-R. I.), presiding, agreed that the two appointments should be acted on promptly, observing that he is well acquainted with Minetti, "A very fine public servant." Sen. John Bricker (R.-Ohio) reported that the committee's chairman, Sen. Warren Magnuson (D.-Wash.), favored action but deferred to Sen. Monroney and agreed to postpone it until Monroney's return from abroad, probably this week.

—Washington staff

USAF Control Over Industry Charged

Manufacturers chafing under procurement rules; Quarles scheduled to hear complaints this week.

By Claude Witze

Washington—Charges that the Air Force seeks excessive and unnecessary control over the aircraft industry, "limiting the ability of management to exercise and use its experienced judgment," will be laid before USAF Secretary Donald A. Quarles this week

Presentation will be made Wednesday at a Pentagon meeting arranged by Admiral DeWitt C. Ramsey, president of the Aircraft Industries Assn. In addition to Quarles, the protest will be heard by his top civilian and military procurement aides.

Ramsey has urged industry executives to attend the session, prepared to speak on the adverse effect of USAF contract terms and ready to cite examples of controls that impede management.

Air Force View

According to Ramsey, there is strong feeling in the industry that the scope and number of government controls has been growing steadily in the past 10 years, most of them imposed by USAF contract terms.

The Air Force view is that stricter control over the manufacturers is vital because of Congressional pressures, the need for economy and the complexity of the modern weapon system. In addition, USAF is responsible for a huge section of the nation's mobilization base, for seeing to it that plants, tools, materials and skilled labor and management are properly dispersed and organized.

A final factor in USAF's argument is the occasional case of mismanagement or out-and-out deception in which the contractor fails to deliver because controls were lacking. In these cases, few as there are, USAF must answer to Capital Hill investigators, who put full responsibility on the agency spending defense dollars.

Indications were that the AIA protest was sparked by East Coast manufacturers, who adopted a resolution condemning several USAF procurement procedures and warning that the practices tend toward "socialization or government control of the essential aspects of aircraft manufacture." The resolution later was approved by the Western Region Aircraft Manufacturers Council of AIA.

Despite this, there were signs last week that full unanimity was lacking. Representatives of three major West Coast prime contractors told AVIATION WEEK they will not be represented at the Pentagon session.

One of them said his firm "will not have anyone at this or any similar conference and no one has been authorized to speak for the company on this subject."

At the meeting on Wednesday AIA's case will be presented by Cramer W. LaPierre, chairman of the Board of Governors, backed by arguments from members of the Aircraft Manufacturers Council.

Disputed Regulations

Backbone of the case will be these USAF contract clauses:

- **USAF Procurement Circular No. 10,** Feb. 11, 1955, requiring with each bid the proposed subcontract structure, listing the parts or assemblies and the name and location of the proposed subcontractors together with the percentage of effort. The circular also requires that there be a contract clause requiring that USAF get prior notice of any deviation in the structure of the subcontract.
- **USAF Procurement Circular No. 1,** Jan. 4, 1956, requiring that the compensation, including salaries, bonuses and other benefits of any contractor be subject to the approval of the contracting officer.
- **"Production control" clauses** proposed recently which give the contracting officer the right to veto and alter the decision of management on all production planning and scheduling operations, including planned manpower requirements.
- **Recently proposed clause** giving the contracting officer the right to make changes in the amount of direct and indirect labor used during the second and third shift.

Some Industry Complaints

It has been known for some time that at least a few aircraft and engine manufacturing executives feel strongly that the development and production cycle for new weapons is being stretched out by military interference with management—particularly USAF interference.

This school argues that the prime contractor is the best judge when it comes to deciding whether an aircraft or engine component should be built at home or subcontracted. They cite the case of the automobile industry, where many items are made by the manufacturer for sound reasons of economy and quality control.

These executives feel that USAF's

USAF Salary Requests Blocked

Washington—Bureau of the Budget has ordered the Air Force to withdraw its requests to government contractors for salary information until it has obtained clearance for the action under the Federal Reports Act.

The order followed a challenge from the Radio-Electronics-Television Manufacturers Assn. RETMA has told its members that USAF's action under Procurement Circular No. 1 may be illegal and they should refuse to give the information until the legality is established.

Provoked by an Air Materiel Command letter requesting salary and compensation data on all employes making more than $15,000 a year, RETMA carried its case to the Advisory Council on Federal Reports, complaining that USAF's request was a general demand for information, not a request for specific costs relating to a particular contract.

RETMA said it considered the request "totally unauthorized by law or regulation" and added that it "constitutes an unwarrantable invasion of corporate privacy and the right of a business to keep confidential the salaries and compensation of its officers and employes."

RETMA also said it believes the questionnaire had not been cleared by the Bureau of the Budget and violates the Federal Reports Act of 1942 and the Executive Order of Sept. 21, 1953 which was issued under the act.

One week after RETMA's presentation, the Bureau of the Budget told USAF "the request for information would be subject to clearance under the Federal Reports Act. If this is correct would you please take appropriate steps to obtain such clearance or have the request withdrawn."

RETMA members now have been told by their counsel that if USAF presses the issue and attempts to get clearance, the Budget Bureau first will seek industry comment. As a rule, RETMA says, clearance is denied if "there are strong and meritorious arguments against it from industry.

Needle-Nose for Missile Research

Modified Lockheed F-94, with long nose radome, is used by Air Research and Development Command to evaluate missile components prior to their installation in test missiles. Malfunctions of the components, which are stored in the aircraft, are noted by its pilot and later rectified by engineering crews. ARDC estimates the program saves price of a missile every other day.

growing insistence on control clauses interferes with efficient production and results in placing too much power in the hands of uniformed USAF representatives, many of them lacking necessary experience to make management decisions.

One company executive has been quoted as saying that "colonels have run—in the fullest sense of the word—the biggest bomber plant in the country. And young captains have dictated to the oldest engineers in this complex business the exact procedure for a minor part development."

Dispersal, Mobilization

USAF spokesmen place emphasis on their obligation to consider dispersal and mobilization factors. Traditionally, USAF has favored subcontracting of at least 40% of the items that go into an aircraft or engine. In the case of the Boeing B-52 bomber the percentage is higher.

Under the new readiness policy—based on the assumption that the United States will fight another war with what it has on hand, in process and away from the scene of enemy attack—it has become even more important to spread the work. In this way some major airframe manufacturers have been brought into the subcontract structure for the B-52, keeping their plants and engineering staffs available for possible increases of the production rate.

A strong declaration of USAF policy was given recently in Detroit by Maj. Gen. David H. Baker, chief of procurement and production at the Air Materiel Command.

"One might conclude that (USAF subcontracting procedures) would result in the Air Force interfering in a prime contractor's business to such a degree as to relieve him of his responsibility for the effective performance of his contract," Gen. Baker said.

Manufacturer's Responsibility

"We consider in the placement of a contract with a company that the company has the full responsibility both managerially and technically, for the performance of the contract. In effect, we are buying management and can never hope to displace that management by government staffing.

"We recognize that private industry exclusively has the ability to gather together in proper balance and numbers the many skills and talents which are required to carry out a productive effort, he said.

"We are willing to financially support such management effort through its contracts and do not desire to reduce or relieve the managerial responsibility of industry in any way.

"However, the Air Force's interest in production extends over a much greater range of products and companies and over a much longer range of time than is significant to any individual company.

"It is for these reasons that the Air Force must interest itself in seeing that the contractor's performance is aimed towards and consistent with the Air Force's national objectives."

Pentagon's Reasoning

Gen. Baker summed up:

"The basic relationship in the managerial area is that we reserve the right to veto 'management decisions in certain specified areas when national objectives are endangered."

At the Pentagon level there is some feeling that this power to veto management decisions must be in the form of more authority than actually needed by a contracting officer. An example of this is in the plant of a manufacturer who is unable to give USAF satisfactory data on quality and production control.

The information is essential insurance, in USAF's viewpoint, because if something goes wrong the Air Force is left wide open to Congressional critics who will demand better monitorship of the contractor.

Congress, in addition, takes an almost passionate interest in the problems of dispersion, small business, profits, areas of excess labor and the utilization of various government-owned facilities.

NSIA Interested

The contract clauses being protested by AIA also have received attention from the National Security Industrial Assn., which includes several aircraft and engine manufacturers among its members.

NSIA officials have met with Gen. Baker to discuss the salary approval circular and the proposed production control clause.

A spokesman for the association said they recognized USAF's problem in these and allied fields and are making recommendations that they feel will help solve them without being too onerous to industry.

NSIA also has examples in its records of hardships caused by USAF's power of veto over subcontract structures. In one of these, the contract clauses results in the paradoxical situation when the Air Force approved choice of a subcontractor and then, in turn, refused to accept the sub-contractor's salary schedule.

At SAE Meeting

Convair Gives First B-58 Engine Details

New York—The problems of propelling supersonic bombers highlighted discussion last week at the annual National Aeronautic meeting of the Society of Automotive Engineers.

In a four-day program heavily laden with papers on engine design and installations, engineers heard the first description of some of the features of the powerplant installation in Convair's supersonic B-58 Hustler. Control systems for a variable inlet, such as used on the B-58, were described in another of the 26 sessions. More than 1,500 engineers attended the meeting.

Propulsion

Convair's C. G. Martin, Jr. told the group that propulsion of a supersonic bomber such as the B-58 has forced consideration of the thermodynamics of the airplane as a system.

Interaction between the high-thrust engines and the surrounding structure, fuel system, accessories and secondary air systems brings a host of formidable problems as the aircraft covers the speed range from zero to twice the velocity of sound. Among them:

• **Wing heating** by the engine exhaust. The use of lower aspect ratios for wings means that the engines are often mounted ahead of a very long chord section of the wing. Convair found that the resultant wing heating from the exhaust blast was critical during takeoff and ground operations. Model tests showed that a twin-engine nacelle presented a severe wing heating problem, but other factors dictated a different configuration and helped reduce the heating. A second major effect stemmed from the inlet geometry of the nacelle. The optimum incidence for cruise performance would have aggravated wing heating; therefore, less than optimum inlet conditions had to be accepted.

• **Local structural loads** from noise. The high-frequency vibration present in the exhaust can cause local failures in nearby structure. Convair simulated the problem on the ground with a Pratt & Whitney J57 engine discharging near a simulated wing panel. Martin said the testing uncovered problems which would have been extremely embarrassing if they had remained undiscovered until the time for ground run-up and taxi tests.

• **Heating of the fuel.** Thin wings, a necessity in highspeed flight, have a large ratio of surface area to volume. Convair structural specialists developed a construction which was lighter, smoother and had better insulating qualities than conventional designs. Martin suggested that subsonic cruise periods might be used during the mission to cool the fuel before supersonic flight. Solar heating on the ground also presented problems which could be solved by using special finishes to reflect solar radiation, by planning missions to keep planes out of the sun after loading and before the all-supersonic mission, by using insulating blankets to cover the wings during the ground periods, and—as an undesirable extreme—by refrigeration.

Convair's choice of an inlet for the supersonic bomber engine narrowed down to a multiple shock type with variable inlet geometry, automatically controlled. In working out this specific configuration, tests lasting several hundred hours were made in eight different wind tunnels. Complete plots of engine inlet face conditions were sent to the engine manufacturer for his testing program.

Secondary air is used for cooling the engine and accessories, the engine oil, the aircraft hydraulic oil and the compressor air bled for aircraft conditioning.

This air is taken from the inlet upstream of the engine and ducted separately to three ram air coolers.

Control systems for variable inlets were described by Dr. Rudolf Hermann, consultant to the Aeronautical Division of Minneapolis-Honeywell. The division is now producing an engine inlet control system for a supersonic aircraft, probably the Lockheed F-104A or Convair B-58.

Basic function of all types of inlet controls is the same—to position and maintain the shock wave pattern for maximum efficiency. This means that the first shock—which originates as a normal shock near Mach 1 and then becomes oblique at higher speeds—must be held just ahead of the cowl lip for all Mach numbers. The second shock—which is a normal shock—is also held at the lip, just inside the cowling.

The first shock is positioned by moving a central spike, if the engine is podded like the B-58, or by a wedge if the engine inlet is a fuselage-side type like the F-104. The second shock inside the cowl is positioned by bleeding off diffuser air through doors behind the inlets.

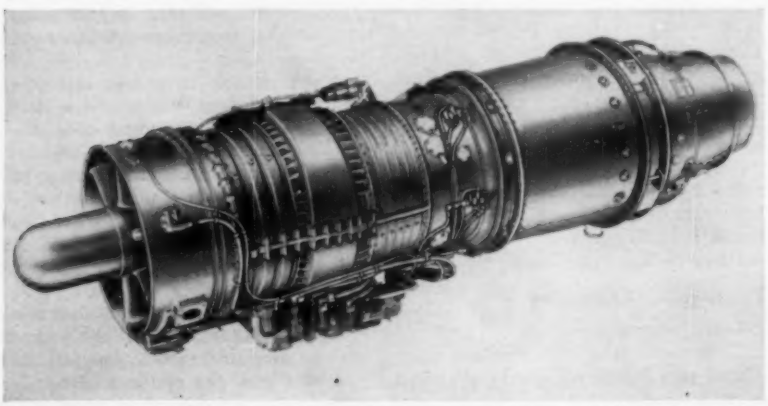
Control Reliability

Control and stability augmentation systems have been duplicated to some extent in the Chance Vought F8U Crusader to insure reliability, Chance Vought staff engineer J. W. Ludwig told a session of the SAE aeronautic production forum.

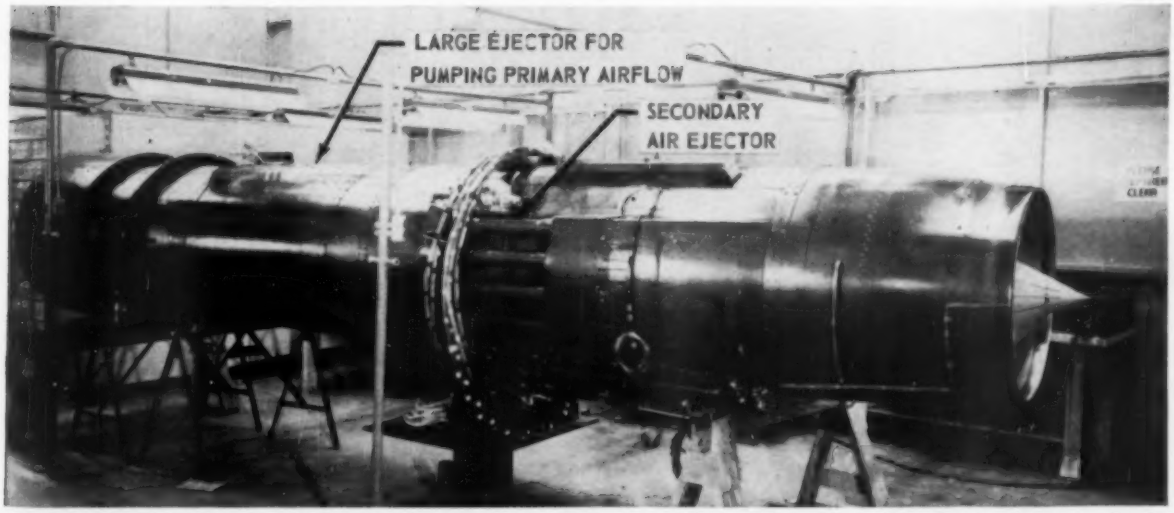
The right and left horizontal tail surfaces of the F8U have separate control systems so that the failure of one

SAE Coverage

The Society of Automotive Engineers' National Aeronautic meeting was covered by an Aviation Week editorial team. The report of the meeting, which begins on this page, was prepared by David Anderton, George Christian, Robert Cushman, Glenn Garrison and Russell Hawkes.



WESTINGHOUSE XJ54 is firm's latest turbojet engine. In the 6,500-lb. thrust class, engine has been under Navy test for several months. Westinghouse claims engine has shown extreme altitude capability, has low specific weight and specific fuel consumption. Company designates the turbojet developed in cooperation with Rolls-Royce the PD-33.



HUSTLER POWERPLANT is simulated by this full-size model made for tests of the anti-icing system and low-speed performance. Central spike forces an inclined shock wave ahead of automatically controlled inlet for efficient recovery of ram air at supersonic speed.

will not result in total loss of attitude control. A neutralizing device presents the inoperative surface from interfering too greatly with the controllability of the airplane.

It was pointed out in the forum that the problem of stability augmentation in modern fighter planes varies greatly between aircraft and that the solutions to the problem also vary. In the F8U, an artificial stability augmentation system was needed about the yaw axis and another about the roll axis.

Ludwig said the F8U was made fail-safe against hard-over signals resulting from failure of a stability augmentation system by duplicating each system and providing for the automatic cut-out of the system should a discrepancy between duplicates occur. Failure of the comparator also results in a cut-out.

Increasing the number of systems and parts in this manner increases the expected number of failures statistically but reduces the possibility of a catastrophic failure.

Ludwig said the loss of stability augmentation on either axis is not dangerous if stability augmentation on the other axis is retained, although the value of the airplane as a tactical platform is reduced.

In the high Mach number regime the stability augmentation systems in many cases have greater authority over the airplane than the pilot because of the decreasing amplitude of control surface deflections which he can be permitted to make without danger of structural overloading.

George Lemke of Convair said that in connection with the F-102 it had been found that the human pilot was a "poor servomechanism" for countering high-frequency (one cycle per second) oscillatory instability. The lag in correction caused by pilot reaction time may bring the correction into phase with the oscillation and result in wider and wider divergence.

The panel recommended the packaging of equipment and control components to make replacement easy but repair impossible.

Human Factors

Lt. Col. John Stapp, chief of the Holloman Air Development Center Aero Medical Laboratory told an SAE forum that rocket-powered ejection seats may be the solution to the problem of inadvertent ejections while the airplane is standing on the ground. From two to six fatal accidents of this type have been occurring each year.

Although successful ejections have been made during a 150-knot take-off run with the stabilized Martin Baker seat in Britain, the forward movement of the aircraft provided sufficient ram effect to open the pilot's parachute and lower him to the ground safely.

Stapp pointed out that no cartridge-type ejection system can be designed which will provide a safe escape from a motionless airplane. The human body cannot withstand the accelerations caused by a cartridge powerful enough to lift a man to an altitude which would allow time for separation from the seat and deployment of the parachute without any ram effect. He said that the rocket-powered seat will lift the crew member 140 to 150 feet into the air at the zenith of his trajectory.

Robert J. Heyman and Robert M. Stanley of the Stanley Aviation Corporation pointed out these advantages of escape capsules:

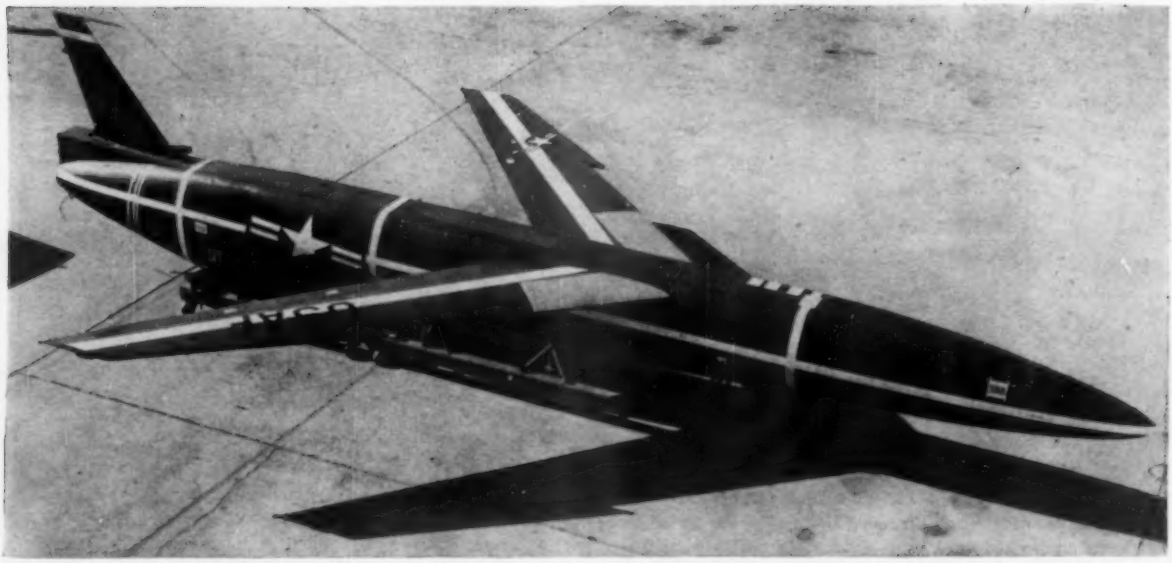
- **Trajectory** can easily be stabilized.
- **Mass and aerodynamic shape** may be such that violent wind drag deceleration can be avoided. In his own paper Stapp suggested that a small rocket powerplant could be provided to counter the effect of drag.
- **Tumbling** can easily be prevented.
- **Occupant is protected** from loss of clothing and equipment.
- **Occupant is protected** from injury by the impact of the air.
- **Loss of oxygen** and pressure can easily be forestalled.
- **Capsule can carry** food, water, clothing, medicine and equipment to ease the survival problem of the occupant after landing.
- **Capsule can be designed** to float in the event of a water landing and can even be provided with stub wings so that the occupant can "fly" it away from undesirable landing areas.
- **Weight penalty** for the installation of a capsule may be less than anticipated—possibly as low as 200 lb.

Heyman and Stanley said the linear deceleration of a man in an ejection seat ejected from an airplane traveling at 1,000 knots would be 100 G's which is more than the human body has survived for a period of time comparable to that encountered during escape from an airplane.

Two-thirds of the USAF's known-cause accidents during 1955 were caused by human factors.

Most of these were the result of pilot error, according to Col. H. G. Moseley, chief of the Aero Medical Safety Division of the USAF Directorate of Flight Safety Research. And most of the pilot errors were due to the inability to meet various routine conditions of flight.

Inexperience is the major cause of pilot error. Moseley said; inadequate knowledge of the airplane and the en-



NORTHROP SNARK INTERCONTINENTAL MISSILE. NOTE FLATTENED TOP OF OTHERWISE ROUNDED FUSELAGE.

vironment makes the number-one accident statistic.

Ranking right behind inexperience is the lack of intensity or breadth of attention by the pilot. Failure to monitor instruments or controls and target fascination have caused the second-ranking number of accidents.

Other contributing items to the human factors of accidents: deficiencies in mechanical equipment or instruments; complications of and distractions from the normal routine.

Most of these causes are largely remedial in nature, Moseley added. They present a real challenge to the designer of high-performance aircraft.

Extreme-Altitude Flight

Five problems of flight at extreme altitudes were outlined by Dr. John R. Poppen:

• **Reduced atmospheric pressure.**

• **Temperature changes with altitude.** At higher altitudes, a reversal in the temperature lapse rate to a positive value will compound the heating problem caused by the airframe skin friction and adiabatic compression encountered in high speed flight.

• **Acceleration**—linear, centripetal and angular. Accelerations of rapid onset produce highly dynamic vibratory responses which attain magnitudes that are multiples of the static stresses. The effect of weightlessness or absence of acceleration cannot be thoroughly studied until it is encountered in space, and the extent of the problem it poses is not known.

• **Vision** at extreme altitude. The reduction in sky brightness and light diffraction and the substitution of the earth as the main source of light will place many working areas in deep shadow. The contrast between the dark sky and light reflected from the vehicle may prove to be intolerable. Because there is no object in space to provide a reference for focusing the eyes, "empty field myopia" results. The normal eye becomes near sighted and the far sighted eye focuses beyond optical infinity. The lack of reference may distort orientation and distance estimation.

• **Radiation**—although radiations emanate all along the track of a particle, the emanations reach their highest concentration during the "thin-down" at the terminal end of the track. This means that partial impedance of radiation by shielding or penetration of the body may increase its harmfulness.

VTOL Studies

The Air Branch, Office of Naval Research, has been using its unique flexibility of Research and Development fund allocations to encourage and coordinate the development of the various pioneer VTOL (vertical takeoff and landing) projects in this country and abroad, according to ONR's Alexander Satin.

Some of the nine projects included are: Aerodyne, Collins Radio Corp.; Hunt Dragonfly and BLC, Fairchild Aircraft Division; Breguet in France and Short Brothers in England (both through Mutual Weapons Development Funds); Ryan's 69 and an undisclosed Vertol project.

Piasecki Aircraft also is negotiating on a light-weight VTOL.

Satin expects that the nine flying "testbeds" will shorten the wait for operational VTOLs from 10 to 20 years down to five to 10 years.

Significant small engine work for VTOL is being carried out by Blackburn Ltd. in England where French Turbomeca engines are being refined to fill the gap in very light-weight shaft turbines in the under 1,000-hp. size. Satin stresses that in contrast to the painful early history of helicopter evolution, VTOLs will come rapidly because of this organized but diversified effort.

Papers presented by C. H. Zimmerman of NACA, R. J. Woods of Bell and K. S. Coward and E. R. Hinz of Ryan further backed the conclusions of the January IAS meeting (AW Jan. 30, p. 30) that the know-how has actually gone past the point where there is no further excuse to delay getting into prototype hardware. So far VTOL is one field where the U. S. appears to have taken the initiative.

There is a hot industry competition for the VTOL development dollar. In

New Hughes Company

Howard Hughes has announced he will "establish a Florida company which will engage in the design, development and manufacture of airplanes."

Neither the type of plane nor the location were revealed, but Hughes' representative, Phoenix contractor Del Webb, said the plant will cover 30,000 acres and include a new airport. He said it will not necessarily be located near an established population center.

Speculation on what Hughes plans to build includes atomic airplanes, chemical-fuel bombers and turbo-transports.

HIGH-SUBSONIC SNARK BLASTS OFF WITH AID OF BOOSTER ROCKETS. SNARK HAS INTERCONTINENTAL RANGE.

this competition Robert J. Woods of Bell, said he felt funds misapplied to "half-away STOL" (short-take off and land) projects are threatening to starve the more important "all-out" VTOL efforts.

No definite VTOL configuration has emerged as superior to all others: instead the experts are showing a spectrum of VTOLs which range from the long-hovering-duration, slow cruising semi-helicopters at one end to short-hovering-duration, fast-cruising tail sitters at the other end.

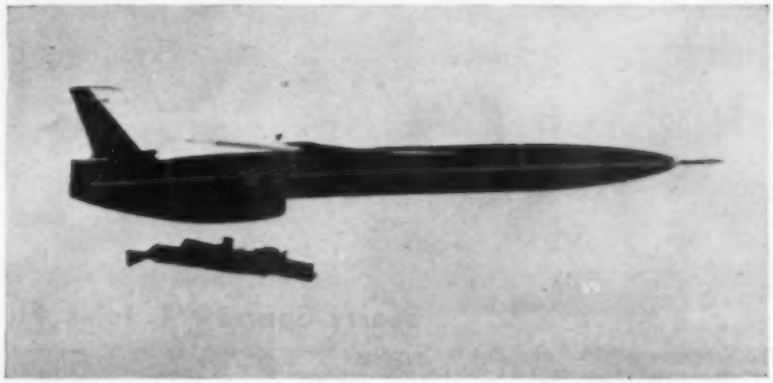
In the middle, and most enthusiastically proposed, are turboprop transports. The problem appears to narrow down to which type of wing-propeller combination to tack on to the conventional transport fuselage.

Transport

A proposed 60-passenger short/medium range transport with a 400 mph. cruising speed, powered by two turboprop engines plus two small wing-tip turbojets, was described by G. D. McVicker, Convair's assistant manager of commercial sales.

The aircraft, McVicker said, was designed to be competitive contemporary medium-range piston equipment that had been fully depreciated. The airframe is basically that of the Convair 440, and the preferred configuration uses Allison T56 turboprop and Fairchild J44 jet engines.

Immediate development of an integrated system for utilizing the nation's "vanishing" and "extravagantly wasted" airspace was urged by Stuart G. Tipton, president of the Air Transport Association.



AIRBORNE AND WITH GUIDANCE SYSTEM taking control, Snark releases booster container. Note upward deflection of wings. Cruise power is supplied by an Allison J71.

Lockheed, Convair Get Atom Plane Contracts

Washington—USAF's Air Research and Development Command has awarded contracts for further development of an airframe for a nuclear-powered airplane to Lockheed Aircraft Corp. and Convair Division of General Dynamics Corp. Lockheed announced it will build a research and test facility on 10,000 acres in northern Georgia, 50 miles from its production plant at Marietta.

Convair's work will be done at its Ft. Worth, Tex., facilities. Convair already has flown a nuclear reactor in a modified B-36 to study shielding and other problems.

Working with Lockheed on the powerplant aspects of the contract will be Pratt & Whitney Aircraft; Convair's partner powerplant development will be the General Electric Co.

Lockheed plans to begin construction by May or June and expects to employ up to 500 people eventually. W. R. Rhoads, former chief staff engineer at Lockheed's Georgia Division in Marietta, has been named director of the new facility. The site will include "buildings to house the reactors," Dan J. Haughton, vice president and general manager of the Georgia Division said.

USAF will provide some of the funds but Lockheed pointed out that it will spend "many millions of dollars" to adapt Georgia operations for atomic aircraft work. The company announced last month that it plans to spend $7,500,000 toward developing "a completely integrated aircraft plant" in Georgia. That includes plans for an advanced design engineering office building and supporting research laboratories at Marietta.

Sperry Sparrow 1 Joins Fleet

The Navy announced last week that the supersonic Sperry Sparrow 1 is one of four missiles that have been sent to the fleet "in quantity" (see story below). Shown here on wings of Chance Vought F7U-3M Cutlass, the 12-ft.-long Sparrow is powered by an Aerojet solid propellant rocket and has made successful attacks against jet aircraft and other missiles.

Delivery Delays Slow 'Modernity,' Navy Says

Washington—Navy has reduced its long-range procurement program from 2,400 planes a year to 2,000, due to a statistical recomputation of attrition and obsolescence.

The Fiscal 1957 budget of $1.6 billion will provide for the purchase of only 1,468 aircraft. However, planes procured with previous appropriations will bring aircraft deliveries up to approximately 2,000 a year through 1958.

Vice Adm. Thomas Combs, Deputy Chief of Naval Operations for Air, said "this quantity is, in general, adequate to support our quantitative requirements. On the other hand, deliveries of the newer and advanced aircraft have not met our planned schedules with a resultant delay in the achievement of optimum modernity."

Following are other points made by naval spokesmen in testimony before the House Military Appropriations Subcommittee on the Fiscal 1957 budget:

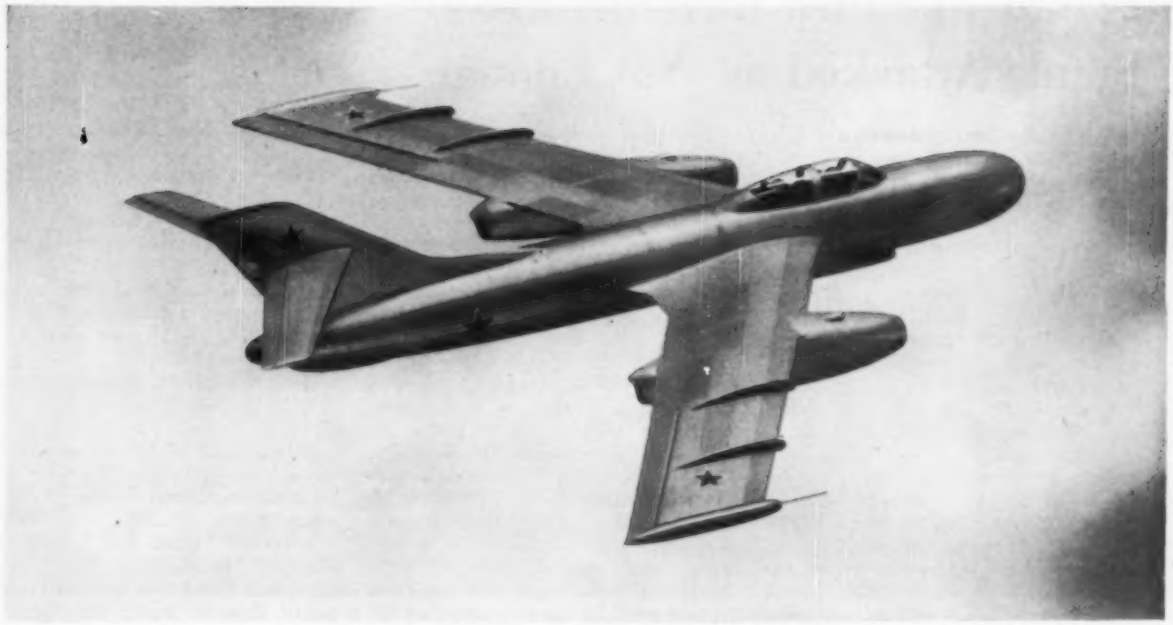
• **A "fleet capability"** now exists in all types of guided missiles, Assistant Secretary of Navy for Air James Smith reported. He said that four missiles have been supplied to the fleet "in quantity;" the Sparrow, air-to-air, the Terrier, surface-to-air; the Petrel, air-to-surface, for use against ships at sea; and the Regulus, surface-to-surface, which can be launched from submarines, cruisers, and carriers. He said the Navy's intermediate-range ballistic missile program to provide an early sea-based ballistic missile "is well underway."

• **Defense Department** has approved and provided funds to the Navy for "a very active nuclear-powered seaplane program." Rear Adm. James Russell, Chief of the Bureau of Aeronautics, reported that "we are placing major emphasis on the development of a water-based nuclear-powered weapons system."

• **Navy has 254** transport-type aircraft available for lease. "We would like to lease those planes, if we could," Adm. Combs said.

"They are doing us no good sitting there on the ground and not in use. They have a potential." Navy is now negotiating for the lease of 30 R4Ds.

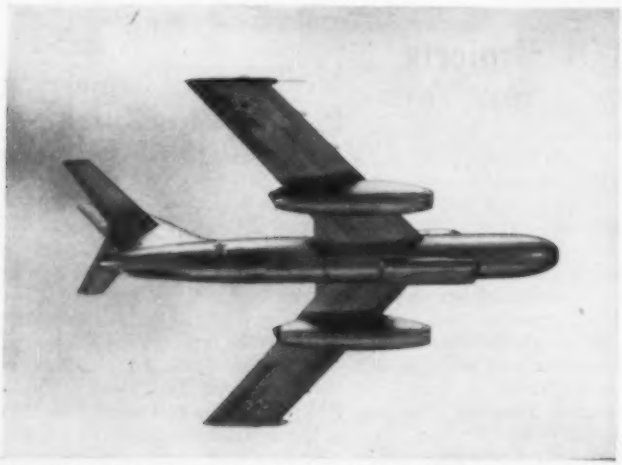
• **Adm. Russell** said "it is absolutely essential that we reduce the time which is required to develop a new aircraft model to the point where it is ready for fleet operational use." To accomplish this, he said, BuAer is taking two new steps: (1) Starting production engineering and procuring long-lead-time tooling for new models in advance of programming their production; (2) Providing funds to procure "sufficient quantities" of pre-production models to permit accelerated test and evaluation programs.



NAVY MODEL of Soviet twin-jet interceptor shows sharp sweepback (40 degrees) of wings. Fighter is manned by pilot, radar operator.

Flashlight: Soviet All-Weather Interceptor

WING with slight anhedral is mid-mounted on fuselage.



ROCKET TRAY is located on belly directly beneath the cockpit.

THREE VIEW points up clean lines of the angular fighter.

President's Plea for More B-52 Funds Attacked as 'Not Enough'

By Katherine Johnsen

Washington—Congressional Democrats have termed the President's request for a $248.5 million additional Air Force appropriation to increase B-52 production "better late than never" but "not enough," and have opened a drive to increase the amount.

The President asked for $547.1 million additional in military appropriations:

- **Army**—$55 million for construction and operation of the Distant Early Warning radar line.
- **Navy**—$65.6 million for seaward extension of the DEW Line, conversion of three conventional ships under construction to guided missile capacity, and conversion of two ships for experimentation in the missile program.
- **Air Force**—$376.5 million, including $128 million for extension of the DEW Line and additional bases for the Strategic Air Command, as well as the $248.5 million to increase orders for B-52s and also to speed up production.
- **Department of Defense**—$50 million for the emergency fund to meet unforeseen requirements in missile program.

Democratic reactions included these:

- **Sen. Richard Russell (Ga.)**, chairman of the Senate Armed Services Committee, who early this year called for a $1.5 billion increase in the Air Force budget, said he is "not completely satisfied" with the Administration's plan to speed B-52 production. He said he understood the plan is to increase production to capacity in existing facilities, and suggested that it may be necessary to tool up two or three more plants to step up production still more. Air Force has submitted a memorandum to Russell stating how it would use an additional $1.5 billion.
- **Rep. Daniel Flood (Pa.)**, a member of the House Military Appropriations Subcommittee, is drafting amendments to the Fiscal 1957 defense budget which would boost the USAF allocation by about $750 million—instead of the $376 million proposed.
- **Rep. George Mahon (Tex.)**, chairman of the Military Appropriations Subcommittee, considered the President's fund request "a minimum" and said he may go along with the move to further increase the figure for USAF. But he pointed to the futility of appropriating funds—if the Administration declines to use them. Mahon discounted a proposal that has been discussed in Democratic Congressional circles that USAF be given a $1.5 billion "blank check" to use as it sees fit, commenting that military budgetary control is "already too loose."

The first public showdown on USAF's Fiscal 1957 program will come when the House acts on the Fiscal 1957 defense budget, probably the first week in May. The Military Appropriations Subcommittee has completed hearings on the budget requests.

By the time House action comes on the budget, hearings before the Senate Armed Services Subcommittee to evaluate airpower, headed by Sen. Stuart Symington (D.-Mo.), will be well under way. They are scheduled to start Apr. 16. One Democrat on the subcommittee, Sen. Henry Jackson (Wash.), already has called the President's program to increase B-52 production "inadequate" and predicted there will be a further step-up "once the facts are brought out" by the subcommittee.

Congressional Republicans discount suggestions that the President's request was a strategic move to counter the Symington subcommittee's investigation and the move in the House to strengthen the Air Force program and keep the Administration in the lead on defense. Sen. Leverett Saltonstall (R.-Mass.), ranking Republican on the Symington subcommittee, emphasizes that the Fiscal 1957 budget estimates were drawn up last fall and that the additional request simply reflects the "latest needs" as shown by more recent reviews.

Even with the $376 million additional, USAF's budget will be almost $2 billion short the $18.9 billion budget asked by USAF in October.

The $248.5 million additional for B-52s will bring USAF's Fiscal 1957 allocation for aircraft and related procurement to $6 billion—$500 million less than USAF's request.

Four STOL Projects Begun by Army, Navy

Washington—Four projects calling for development of short takeoff and landing (STOL) aircraft have been launched by the Army and Navy.

Army's contracts, awarded by the Transportation Corps, mark a new departure in research and development effort. The first awarded by the Army, they call for evaluation of "test bed" aircraft built on a reduced scale at 10 to 20% of the normal cost for work of this type. The companies:

- **Fairchild Aircraft Division**, Hagerstown, Md., $1,007,087.
- **Doak Aircraft Co.**, Torrance, Calif., $341,673.

Army emphasized that its contracts do not call for operational aircraft but will result in applied research to further the state of the art.

Navy has not announced its contracts in the STOL field but authoritative sources said two R&D projects have been authorized. They will go to:

- **Ryan Aeronautical Co.**, San Diego, Calif.
- **Vertol Aircraft Corp.**, (formerly Piasecki Helicopter Corp.), Morton, Pa.

Army's interest in STOL aircraft clearly envisages their eventual use to replace present assault planes such as the Fairchild C-123 now operated for the Army by USAF.

Gen. Maxwell D. Taylor, Army chief of staff, has said he has no ambition to take over the assault transport mission but that STOL performance is awaited because such planes will "do for us in the air what trucks do for us on the ground."

AVIATION WEEK has learned that Fairchild's proposal to meet this demand will incorporate four engines and special flaps to insure substantial lift over the entire surface of the wing.

The Doak contract calls for work on a conventional aircraft which has a ducted fan at each wingtip that can be turned through 90 degrees. It will be powered by two gas turbine engines, geared to drive the fans.

Ryan is known to be working on a propeller-driven design, probably similar to the Fairchild proposal. It would employ an elaborate flap system that will result in a deflected slipstream for vertical takeoff and landing.

Vertol has said it considers helicopters only one type of VTOL aircraft in which it is interested. No design details have been disclosed, but the company in the past year has expanded its R&D effort to cover the demand for aircraft outside the rotary-wing field.

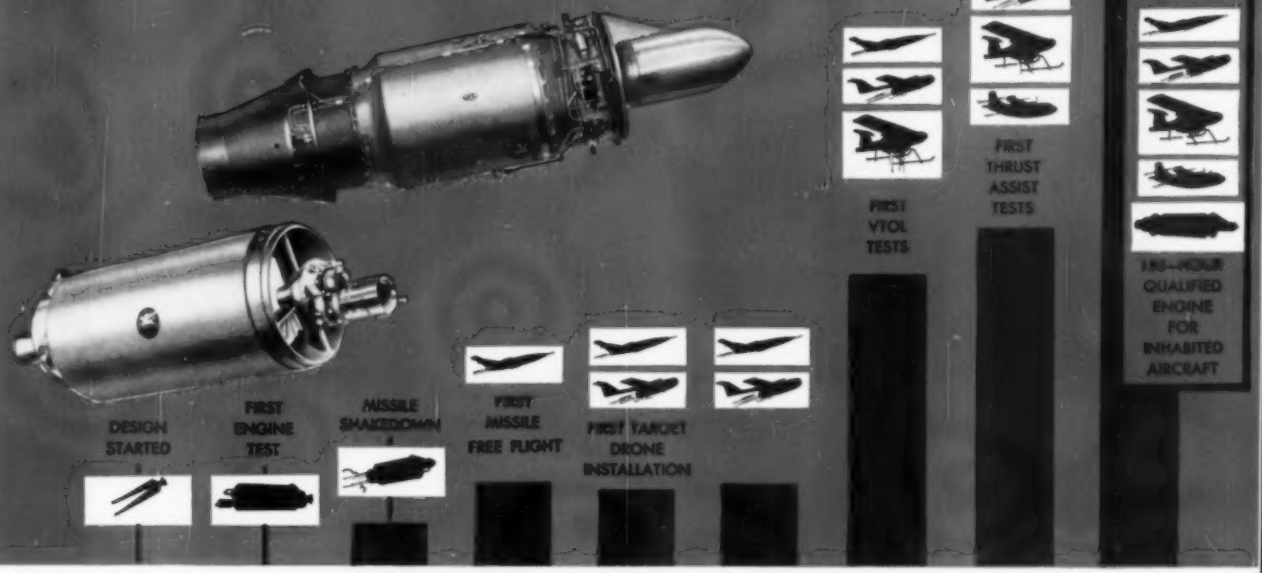
Army said its program, combined with those of the Navy and Air Force, will "investigate and establish advanced aerodynamic design principles."

Weejet Navy Trainer Proposed by Carma

A new side-by-side light jet primary trainer for the Navy is being flight tested by Carma Manufacturing Co., Torrance, Calif. Powered by a Continental J69-T-9 of approximately 920 lb. thrust, the "Weejet" has a gross weight of 3,440 lb., span of 27.7 ft., length of 22.8 ft. and a top speed exceeding 300 mph. at sea level.

Scheduled to be flown last week to the Naval Air Test Center, Patuxent River, Md., for evaluation, the Weejet is the first airplane built by Carma, an electrical and mechanical equipment manufacturer.

EVOLUTION
FAIRCHILD J44 TURBOJET



ANNUAL PRODUCTION

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Here's how a new era in small jet development was pioneered.

More than seven years ago, Fairchild Engine Division began work on the mighty J44, a power-packed, bantam-weight turbojet, to power guided missiles, target drones and pilotless planes.

Its 150-hour military qualification tests completed, the J44 can now be put to work as thrust assist on multi-engined military cargo and transport aircraft; or as part of auxiliary power and boundary layer control systems.

From the beginning, Fairchild engineers have continually designed increased performance, reliability and ruggedness into the J44. Faster speeds, higher altitudes were achieved, and with them, a wider and wider range of new applications.

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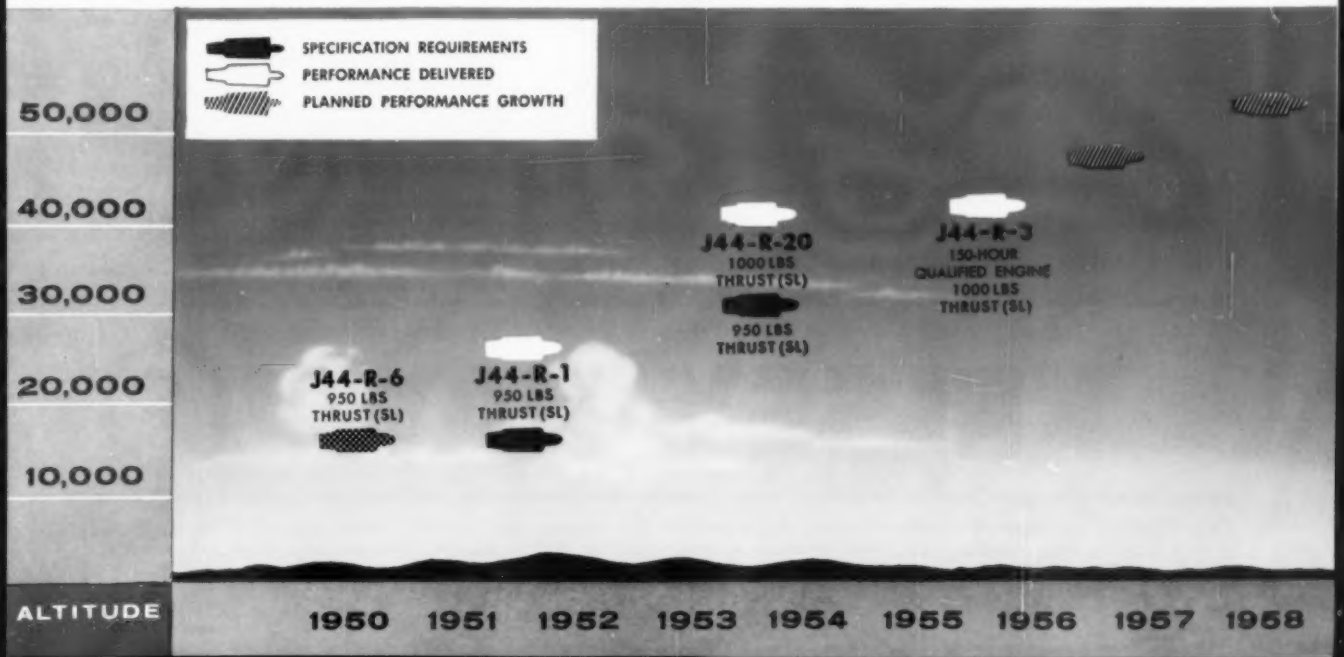
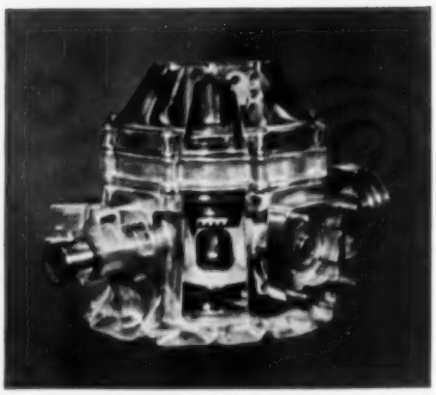


Crop destroying pests—gone with the whirlwind.

Kelsey-Hayes helps Bell put whirlwind power in the 47-G

1,800,000 cu. ft. of air per minute! That's the amazing downwash of the Bell 47-G Helicopter. Power to propel this versatile rotorcraft flows smoothly through a precision-geared transmission produced for Bell by SPECO, the Steel Products Engineering Division of Kelsey-Hayes. For over 40 years, the manufacture of precision gears and gear assemblies for aircraft has been a SPECO specialty.



Bell 47-G transmission is one of over 100 parts produced by Kelsey-Hayes for the 47-G helicopter. Other products for the aviation field include *accessory gear assemblies, actuators, computers, controls, bomb hoists, gun turrets, radar tracking and scanning assemblies, power recovery units, compressor rotors and turbine sections, blades, buckets, vanes.*

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"Man's reach should exceed his grasp, or what's a heaven for" – Robert Browning

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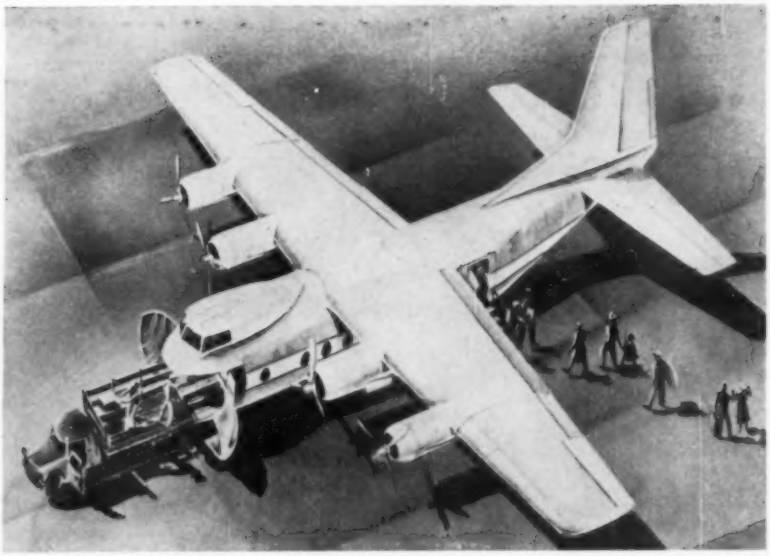
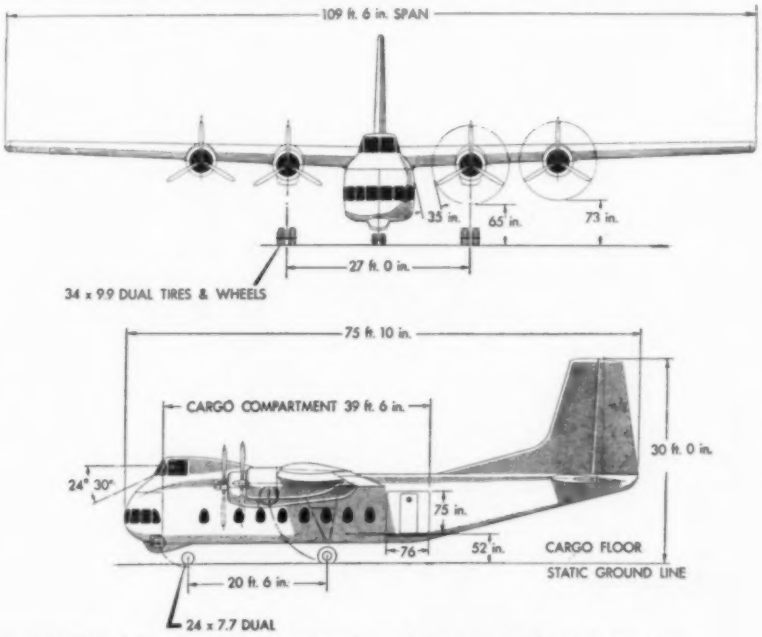


ARTIST'S SKETCH SHOWS how nose in Safari cargo version swings open to accept freight.



TWO-VIEW of Frye F.1 shows transport's configuration and basic dimensions.

Design Features of Frye Safari

Final specifications for the Frye F.1 Safari short-haul transport indicate that the aircraft will have a direct operating cost of 0.0133 cents per seat mile while carrying 51 passengers on local-service flights of just under 100 mi.—this compared with 0.022 cents for a 21-seat DC-3.

As a freighter, the Safari has been designed to carry up to 12,000 lb. of cargo at direct ton-mile costs of 10-11 cents over short-haul routes, according to Jack Frye, president of the Frye Corp., which was organized specifically for the design and production of the F. 1.

The company has reported initial orders for the Safari from Northern Consolidated Airlines, Anchorage, and Wien Alaska Airlines (AW Mar. 19, p. 81).

The prototype F. 1 is expected to make its first flight in February, and first deliveries are scheduled for July. Production will be contracted to an outside firm (Temco Aircraft Corp.,

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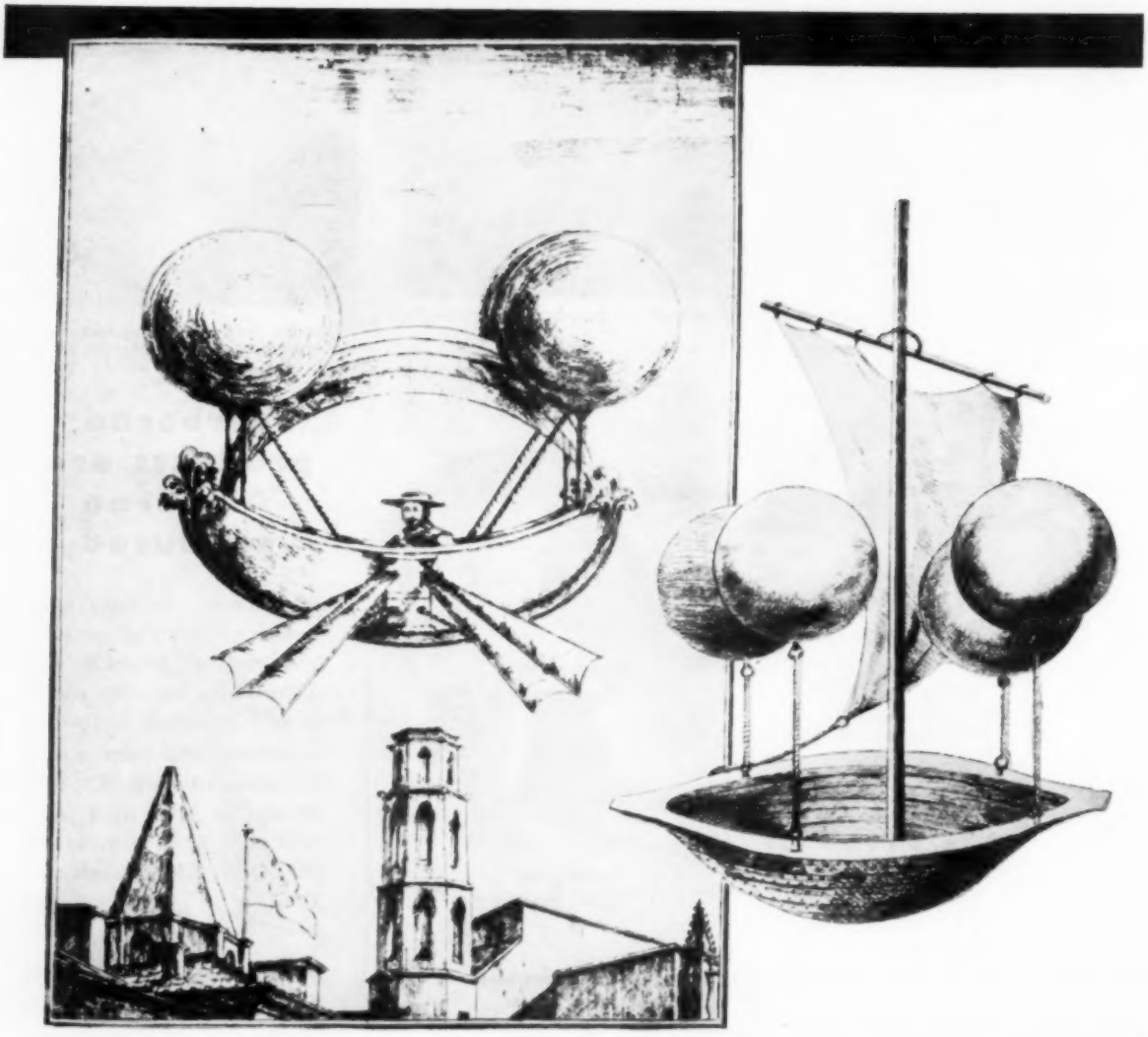
MAN'S CONQUEST OF THE AIR

Lana's Flying Boat



Of the many ways by which men have tried to fly, here is one of the strangest. It involved pumping all the air out of four copper globes attached to a boat-like car. This aerial chariot was designed by Francisco Lana in Italy about 1670.

What Lana didn't know was the actual pressure and density of air, or he might have seen his error. Both of these were determined two years later. Even so, the idea still attracted attention nearly 200 years afterwards. In fact, a Frenchman, Marey Monge, actually built a machine from Lana's plans and tried vainly to fly it in 1843.

We may smile at Lana's flying boat now, but it was out of such trial and error that man finally flew. Today ESSO research, which has played an important part in the development of superior aviation petroleum products since the start of powered flight, is continuing to seek new and better ways to help men fly.

Another reason why most operators specify

ESSO

INTERNATIONAL AVIATION PETROLEUM SERVICE

Dallas, has been mentioned unofficially as the likely builder). The Frye Corp. is in Ft. Worth.

The lowest price for the aircraft will be $365,000, this for the all-cargo version with fixed landing gear and four 600-hp. Pratt & Whitney Wasp engines.

The same aircraft in basic passenger configuration will cost approximately $395,000.

Retractable landing gear also will be available on order.

The firm is offering customers a choice of other engines: the 825-eshp. Lycoming T53-L-1 turboprop; the 820-hp. Alvis Leonides Major and the 800-hp. Wright R1300 piston engines.

Powered by the 600-hp. Wasps, the Safari is predicted to need a takeoff distance of 2,300 ft. to clear a 50-ft. obstacle when carrying a 14,292-lb. useful load. Landing with this load over 50 ft., will require a distance-to-stop of 1,700 ft. Required field length under Civil Aeronautics Administration rules will be 2,800 ft. at a maximum gross weight of 37,000 lb., the Safari would need a takeoff distance of 2,800 ft. to clear 50-ft. with one engine out, propeller wind-milling and gear down. Safe three-engine climbspeed at this weight is calculated as 80.6 mph. Sea level climb at 37,000 lb. would be 860 fpm.; at 15,000 ft. altitude it would be 440 fpm. cruise speed at 37,000 lb. would be 171 mph. at 8,000 ft.

Features of the freighter version will include built-in floor rails and facilities for loading and locking into place palletized shipments to permit complete turnaround in 10 minutes.

Prototype Viscount 700 Reaches 400 mph.

The prototype Vickers Viscount 700 has been flown at 400 mph. speeds in level flight, according to Vickers-Armstrongs, its manufacturer. The cruise speed of current production Viscounts is 325 mph.

The speed runs were designed to test engine, propeller and air frame behavior.

Advanced versions of the Rolls-Royce Dart engine will give the production-model Viscount 810 a cruise speed of 365 mph. and the Viscount 840 a cruise speed of 400 mph., according to Vickers-Armstrongs. The 810 is due to reach service in 1958, the 840 in 1959.

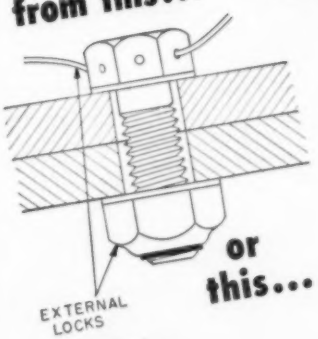
Continental Air Lines has ordered 15 of the new Viscounts, optioned five more.

The Viscount's characteristics during the speed runs, which were conducted at its normal cruising altitude of 25,000 feet, were described as "completely normal."

How to Do Away With Lock Nuts and Lock Wiring

use HELI-COIL* Screw-Lock Inserts

from this...



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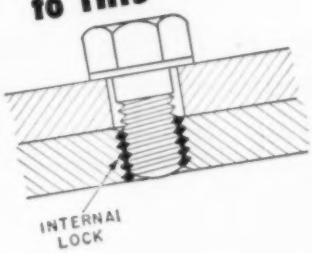

Screw-Lock Inserts meet AN-N-5b and MIL-N-25027 military specifications for lock nuts.

For years designs requiring lock nuts or lock wiring have plagued designers with problems of space, weight and costs. Each lock nut, even a small one, takes space, has weight and costs money. Every bolt locked with wire requires a through hole in the head, positioning and wiring. The simplicity of many a superior design has been lost due to these cumbersome methods of fastening.

Now for the first time good designers can do away with these "design plaguers." They can accomplish the same end results plus a saving of weight, space and money by a new revolutionary concept in fasteners—*Heli-Coil* Mid-Grip Screw-Lock Inserts. This new fastener is a stainless steel wire insert with locking threads. It can be installed easily and puts the locking effect *inside* the tapped hole—protects the tapped threads for life—and locks the mating screw or the bolt with the same torque as a lock nut. This Screw-Lock Insert not only provides a stainless steel protecting thread, locks the screw or bolt, but most important of all—eliminates the space and weight of a lock nut—the wiring necessary in lock wiring.

Heli-Coil Mid-Grip Screw-Lock Inserts can readily be distinguished from regular non-locking *Heli-Coil* Inserts by their distinctive red color.

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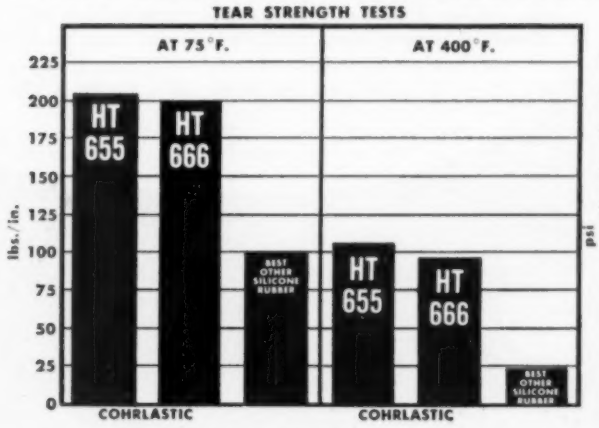
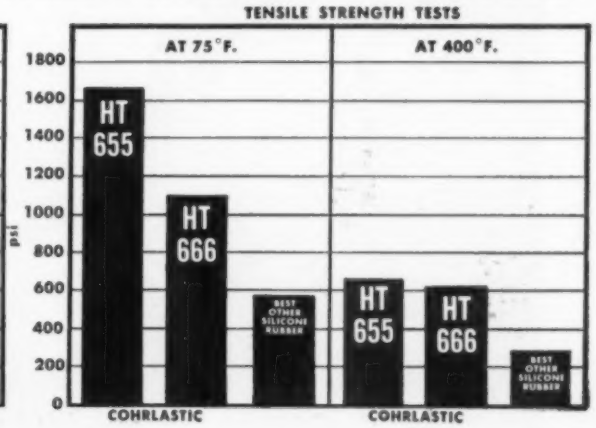
Seals, fabricated from these remarkable compounds, greatly reduce maintenance costs and offer increased service life because of their excellent strength properties at 400°F and good flexibility at low temperatures (−100°F for HT 666, −65°F for HT 655).

Advance tests by process groups of several major aircraft companies have resulted in preliminary specifications of HT 655 and HT 666 for seal design for new jet aircraft. Highly recommended for use as seals for drop tanks, pylons, under wing stores, hatches, windows and drag chute doors.

For information and engineering assistance with your particular seal application, write to: The Connecticut Hard Rubber Company.

TESTS PROVE COHRLASTIC HT 655 AND HT 666 FAR SUPERIOR THAN OTHER SILICONE RUBBERS





typical properties

	COHRLASTIC HT 655 50-Durometer	Actual Value	COHRLASTIC HT 666 60-Durometer	Actual Value
As Received				
Durometer	54		62	
Tensile Strength, psi	1650		1100	
Elongation, %	820		650	
Tensile Stress at 100% Elongation	174		225	
Tear Resistance lbs./in.	206		200	
Dry Heat Resistance, 70 Hrs. @ 400°F.				
Hardness change	+14		+8	
Tensile Strength Change, %	−30	1080 psi	−9	1000 psi
Elongation Change, %	−34	540 0/0	−35	425 0/0
Tear Resistance Change, %	+14	235 lbs /in	+32	264 lbs./in.
Bend (flat)	No Cracking No Checking		No Cracking No Checking	
Compression Set, Percent of Original Deflection				
70 Hrs. @ 212°F.	29		26	
22 Hrs. @ 300°F.	40			
70 Hrs. @ 300°F.	69		65	
Low Temperature Resistance				
Young's Modulus ASTM D-797-46				
at −65°F. Max., 10,000 psi	Pass		Pass	
at −100°F. Max., 10,000 psi			Pass	

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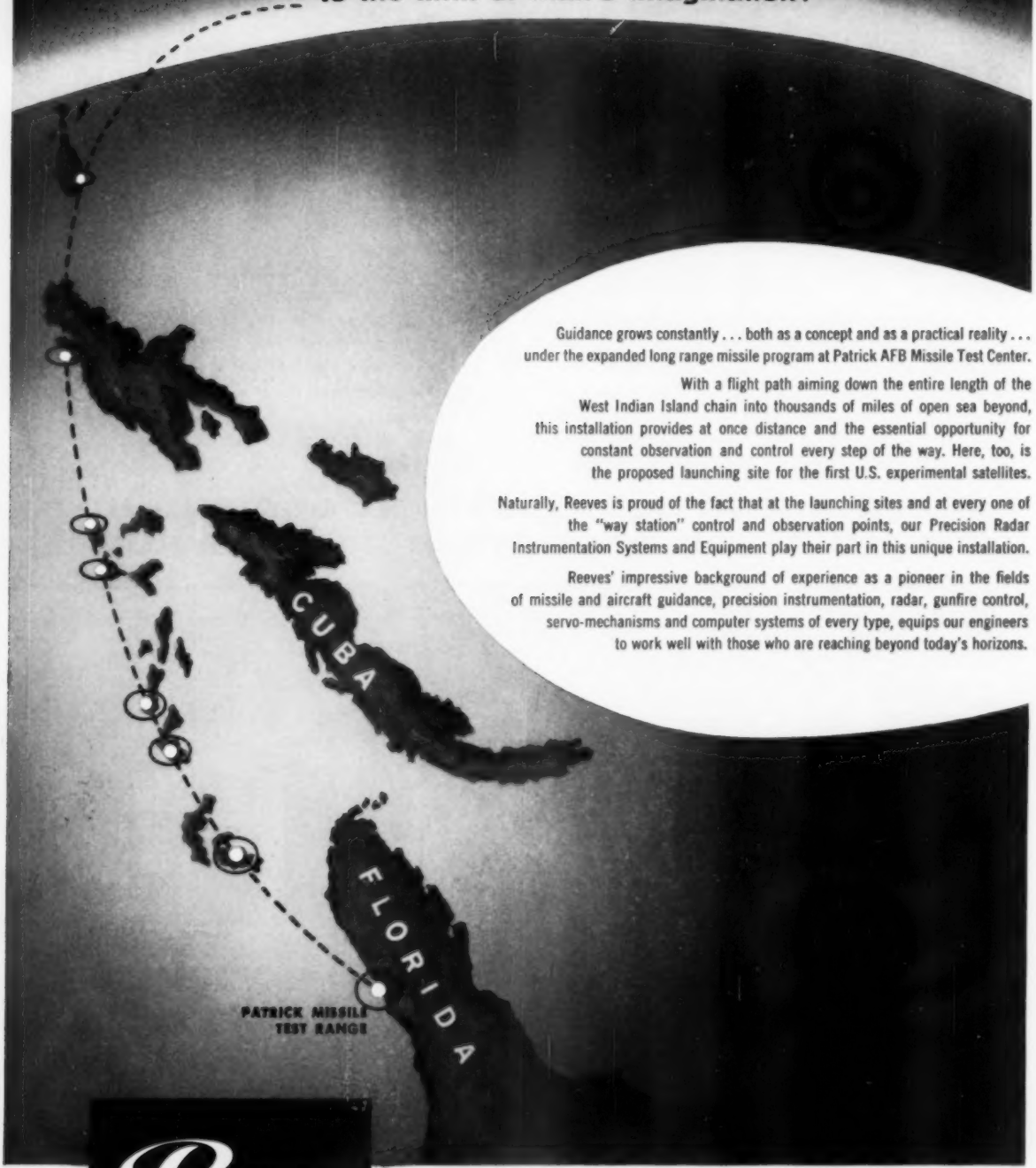

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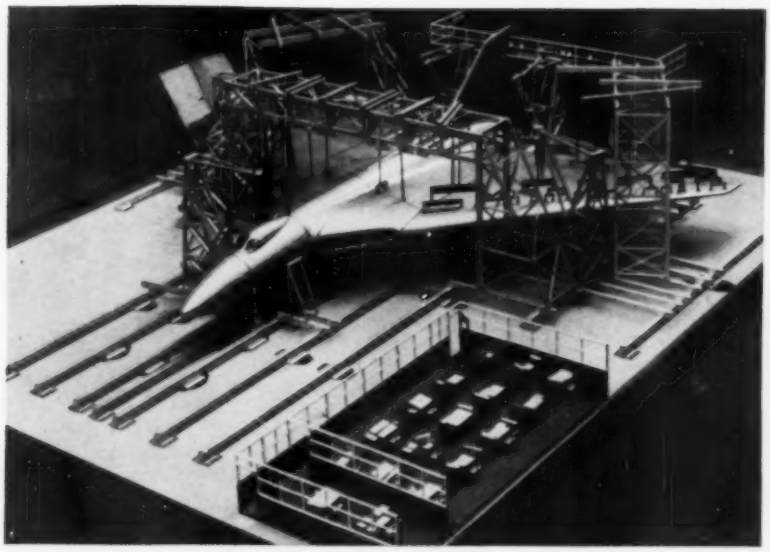


Vulcan on the Rack

Avro Vulcan delta-wing bomber, which has just completed a two-year program of static testing, will next be used for development of large-scale composite wings built of light alloy honeycomb structure. No primary structure failed during the test program; secondary failures occurred, but no important weight penalty is anticipated from the necessary fixes. The structural test rig shown in model form is built on a permanent T-shaped base capable of taking even larger aircraft. The Vulcan under test was suspended from gantries by 22 hydraulic jacks tied in to wing and fuselage. Loads up to 700 tons total were applied to the airframe of the four-jet delta bomber.

Two Rocket Contracts Granted for Vanguard

Two parallel design and development contracts have been awarded for a third-stage rocket to propel Project Vanguard, the earth satellite to be launched in the International Geophysical Year.

U. S. Navy and the Martin Co. of Baltimore announced last week that designs of a new solid-propellant rocket will be made by Grand Central Rocket Co., Redlands, Calif., and Allegany Ballistics Laboratory, Cumberland, Md. Allegany is operated for the Navy by Hercules Powder Co.

Spokesmen for Martin, prime contractor for Vanguard's launching vehicle, said two projects were authorized because of the high performance specified for the contract.

They indicated the third stage rocket will have to set new records that will constitute a "breakthrough" in the state of the art.

First and second stage rockets for Vanguard will use liquid fuel.

Other sub-contractors for the satellite:

• **Minneapolis-Honeywell Regulator Co.**, Mineapolis, Minn. will make a three-axis reference system consisting of gyroscopes to indicate the vehicle's roll, pitch and yaw.

• **Vickers Electric**, division of Vickers, Inc., St. Louis, Mo., has been assigned to build the auto-pilot that will guide the satellite to its orbit 300 miles in the air.

The magnetic amplifier auto-pilot will get its instructions from the gyro reference system built by Minneapolis.

House Group Approves Atom Plane R&D Base

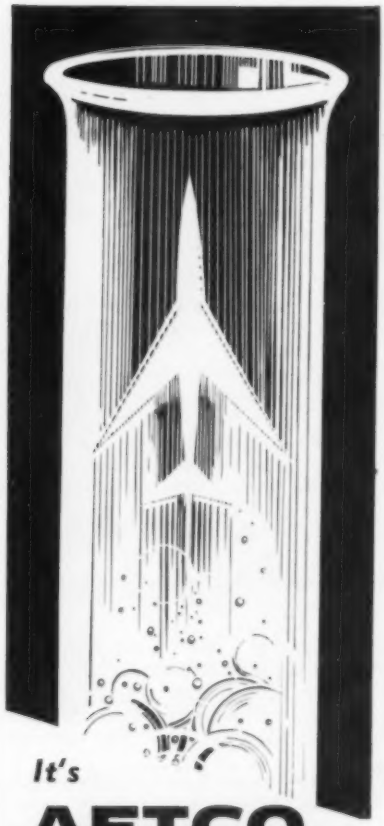
Washington—The House Armed Services Committee has authorized the Air Force $11.4 million to start construction of a new installation for research and development on missiles systems and nuclear aircraft adjacent to the Atomic Energy Commission's National Reactor Test Station in Idaho.

The new project is to be located 40 miles southeast of NRTS.

It will be operated jointly by the AEC and USAF.

USAF told the committee the installation will consist of "an experimental runway, with the necessary minimum supporting facilities such as taxiway, dispersal hardstand, aircraft washrack, communications and navigational aid facilities, a fire station and operations building, a control tower, a decontamination facility and the necessary utilities to develop the area. . . ."

The authorization is included in the



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$2 billion military public works authorization now awaiting House action.

The total $225 million approved for new USAF R & D facilities is "almost wholly for facilities required for the development and testing of nuclear-powered aircraft and new weapons systems, principally guided missiles," USAF said.

Nike, IRBM Funds

The measure also authorizes the Army $140 million for expansion and improvement of Nike defense facilities in this country and at key overseas bases, and $25 million for new facilities for the Army's intermediate range ballistic missile. The IRBM funds are to provide facilities for development of guidance and control components, fabrication of missile prototypes, user-test activities, laboratory and engineering technical functions, launching facilities and range instrumentation.

Other authorizations in the public works bill:

- **Army:** $14.5 million for new facilities for aviation support.
- **Navy:** $205 million for new aviation facilities, including two new jet aircraft bases at Meridian, Miss., and Lemoore, Calif.
- **USAF:** Approximately $230 million for airfield and runway expansions and improvements necessitated by the phasing-in of B-52 bombers and Century-series fighters into training and combat units.

Authorizations by USAF commands include: Air Defense Command, $188 million; Strategic Air Command, $93 million; Aircraft Control and Warning System, $81 million; Research and Development Command, $77 million; Air Materiel Command, $57 million; Air Proving Ground Command, $21 million; Military Air Transport Command, $15.8 million.

New Hydraulics Package Designed for B-52

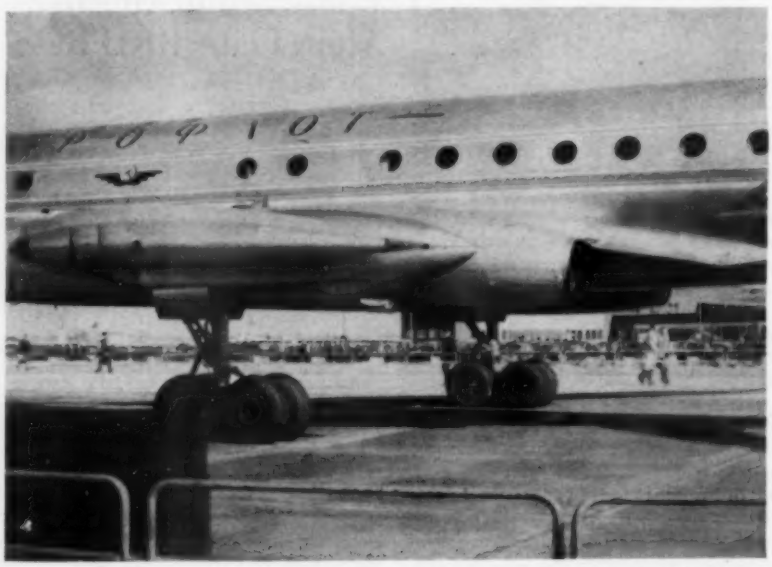
A hydraulics components package that saves over five pounds per unit compared with previous units has been designed especially for the Boeing B-52 Stratofortress. Similar packages are also in the design stage for other aircraft, according to the manufacturer, Parker Aircraft Co., Los Angeles, Calif.

Each package contains two check valves, one depressurizing valve, one by-pass valve, one restrictor, one filter and filter by-pass. The company has saved considerable weight by eliminating six housings; fewer lines, fittings and provisions for mounting are needed.

Each B-52 will use 10 of the packages; resulting in a weight savings of approximately 50 lb. per plane.

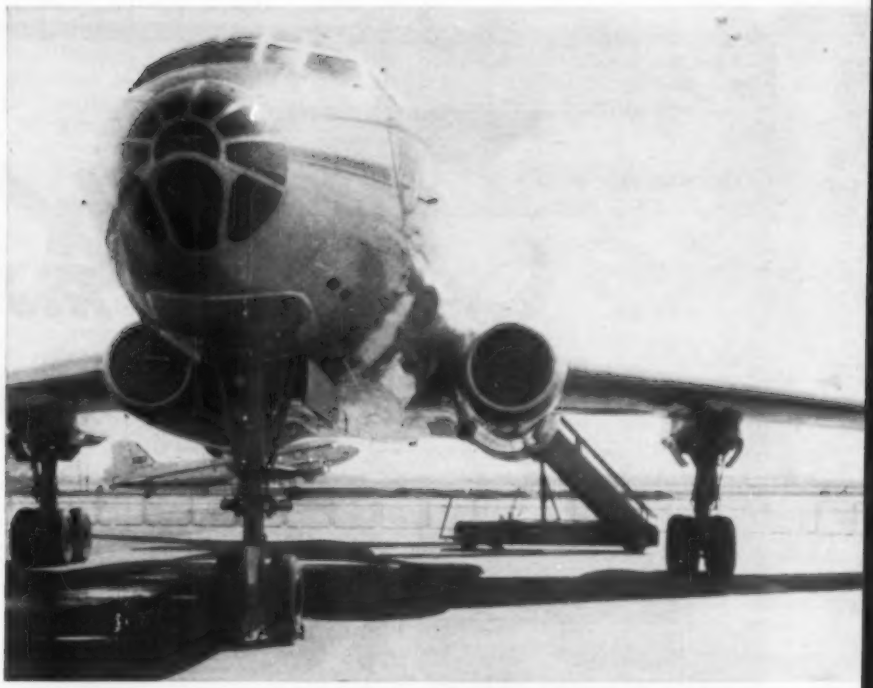
TU-104 PLAN FORM shows in belly view taken at London airport. Note similarity to . . .

Soviet Jet Evolution: From Badger to Tu-104



MAIN GEAR is conventional double bogie type. Main nacelle doors are closed for takeoff.

. . . **BADGER,** shown over Moscow airport.



NOSE GEAR of Tu-104 resembles Lockheed Constellation's; uses lateral shimmy dampers.

New details of the Russian Tu-104 jet transport designed by Andrei N. Tupolev provide further insight into the state of the Soviet aeronautical engineering art.

The plan-view similarity between the transport and the standard Red medium bomber, the Badger, points to the genesis of the Tu-104. The major difference is that the mid-wing bomber configuration has been transformed into a low-wing transport.

Other than that, Badger components seem to have been used throughout.

One neat trick is the venting of wing leading-edge thermal de-icing air at the tips. The two vertical vents can be seen in the pictures.

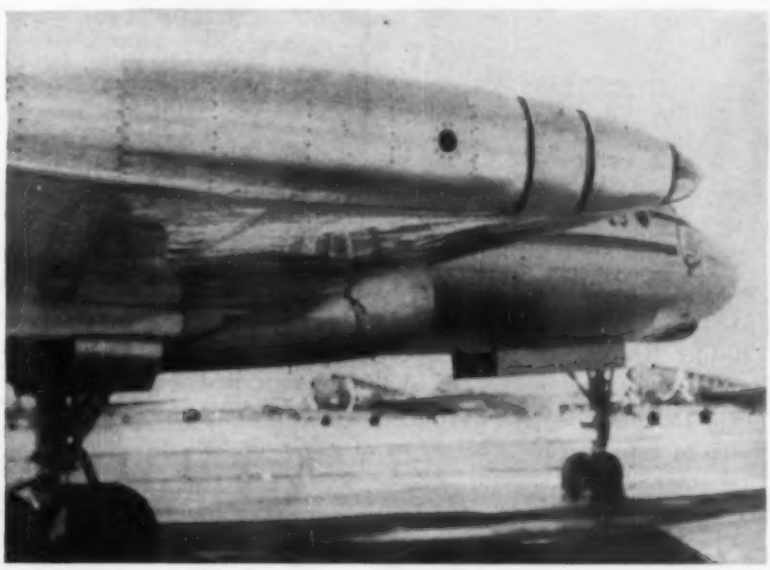
Measurements from the photos indicate the wing thickness is about 10 percent at the tip; root thickness would be higher, perhaps as much as 15 per cent.

Landing-gear layout and position of the doors in the separate nacelles show that the wheels probably retract almost straight up, with the main leg rotating and moving aft to lie flat between the wheels.

Both powerplants and the main landing gear apparently are attached to the rear face of the main spar.

The aircraft's nacelle structures only take local loads.

TU-104 TAIL is swept, mounts antennas.



WINGTIP VENTS are outlets for heated air from engine compressors used to de-ice wings.

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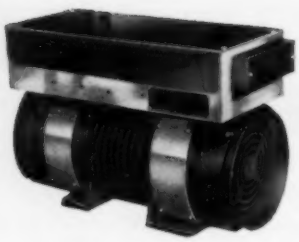
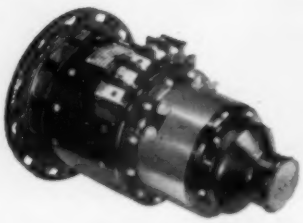
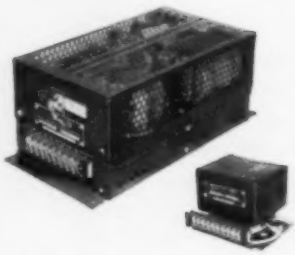


High-Altitude and Missile
INVERTERS



High-Temperature
AC GENERATORS



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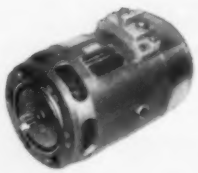
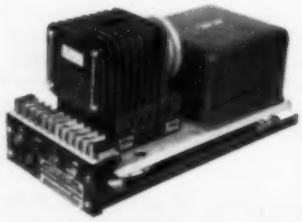


High-Temperature
DC GENERATORS



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Bendix AVIATION CORPORATION

Columbus Airport Increases Revenue

Substantial increases in traffic and revenue were reported for 1955 by Port Columbus, the Columbus, Ohio, municipal airport.

During the year, Port Columbus handled 196,066 aircraft movements, 487,476 passengers and 4,169,014 pounds of freight. Passenger traffic increased 28.6% over 1954, and freight traffic was up 84.4% in spite of the fact that about half of Columbus' freight is trucked to Dayton for air shipment.

Income in 1955 totaled $225,878, and expenses were $176,311, leaving an operational profit of $49,567 for the year. This profit doesn't include payments on bonded indebtedness.

Work on a new terminal for the airport continued in 1955 with a 10-story center section of the project going into service as the new control tower. Modifications of the present terminal were made to accommodate traffic increases until the new structure is complete.

Airliners Set Stage For Jet Transports

New York—While the Communist east continued to preen itself over the political success of Soviet Russia's jet transport (AW April 12, p. 28), several major U. S. airlines are quietly fitting themselves to meet the problems that the Douglas DC-8 and Boeing 707 will bring when they enter service some three years hence. Among steps already taken:

• **Pan American World Airways** retained a former Air Force jet specialist, Maj. Gen. Victor E. Bertrandis, as an adviser on the airline's forthcoming 707 and DC-8 operations. He will help Pan American plan airport facilities and general jet operating procedures.

• **Directors of American Airlines** approved the setting up of a new division within its Operations Department to handle operational planning for "future aircraft," including the Boeing 707s and Lockheed Electras now on order. The new unit will be headed by Vice President Marvin J. Whitlock, former head of the airline's Tulsa base.

• **National Airlines** announced that George W. Haldeman, former special assistant to the director of the Civil Aeronautics Administration's Office of Aviation Safety will be employed in "an executive capacity." Haldeman, the announcement said, has flown more than 300 hours in jet aircraft, both in the U.S. and England. An airline spokesman said National plans to establish a special department to handle jet operations, presumably to be headed by Haldeman.

• **Eastern Air Lines**, already a veteran in the jet-planning field, organized a "jet group" in 1952 under its senior vice-president operations to coordinate the traffic, communications, operations and maintenance aspects of jet transport planning. No new units are planned at the present time.

Trans World Airlines, on the other hand, plans no special departments to help in the transition but will depend upon existing units to "do their parts" in integrating the new aircraft.

A technical development section, under J. A. Herlichy, vice president-engineering and maintenance, will continue to oversee United Air Lines jet planning. United in 1952 ran a paper jet operation to study the economics of turbojet use.

Darwin Plans Expansion To Handle Olympic Rush

Qantas Empire Airways will spend close to $250,000 on improvements to the Darwin International Terminal to handle the expected rush of traffic for the 1956 Olympic Games.

The airline hopes that improvements will enable it to handle four aircraft at once.

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Is Missile Reliability Worth the Cost?

By Irving Stone

Pomona, Calif.—What is the cost of missile unreliability—in dollars and cents and in the loss of defensive capability?

One general view in the widely-debated argument is that a defective anti-aircraft missile might have been the one that would have knocked down an enemy aircraft carrying an atomic bomb.

The cost of such a failure as this would be almost incalculable.

Another is that there will be so many missiles used in any all-out war that the failure of a small proportion would be insignificant.

Still others believe the cost of missile unreliability can be pinpointed through statistical principles and that it is roughly equivalent to the cost of restoring the effectiveness of the weapon system lost through missile failure.

This approach for evaluating savings in weapon system costs has been outlined for AVIATION WEEK by Dr. A. L. Stanly, administrative manager, engineering, and Dr. Joseph Tampico, vice president and director of engineering, Associated Missile Products Corp., a subsidiary of American Machine & Foundry Co.

Testing a guided missile under tactical conditions is an involved and uncertain job because of the extreme complexity of the missile. Under wartime conditions, when missiles probably would be expended at a tremendous rate, they might frequently pass the field checkout test and then fail in flight.

As a result, a tremendous waste would be created. Not only would the cost of manufacturing the missile itself be wasted but also the expense involved in getting the missile to the field and then handling and maintaining it up to the launching time.

Also, the missile's intended target now has a greater chance of remaining unscathed.

The potential waste involved could in many cases be averted by more thorough missile checkout equipment than that normally employed—even though more-expensive equipment would be involved, an overall saving in the cost of the weapon system could be realized.

Essentially, the method proposed by Stanly and Tampico involves weighing the savings in weapon system costs against the cost of effecting these savings.

Source of Savings

Savings result from increasing the missile reliability in the field and achieving the same defensive results from fewer missiles.

The number of missiles which can be eliminated through any given increase in reliability achieved through more effective checkout equipment depends on many factors, including initial missile reliability, number of missiles per salvo, reliability of the launching system and probability of kill of a reliable missile.

For example, Stanly and Tampico estimate that, if the initial reliability of the guided missile is 50% and if an increase in reliability to 60% is achieved through use of better field checkout equipment, approximately 15% of the missiles can be eliminated for the same weapon system effectiveness.

Overall Saving

The proportion of missiles eliminated will depend upon the number of missiles per salvo, ranging as high as 20% for one missile per salvo and as low as 5% if there are six missiles per salvo, they say.

The overall saving in weapon system cost resulting from an increase in reliability through use of more effective checkout equipment involves more than just the cost of the missiles themselves, since the reduction in the number of missiles required also permits a reduction in other components and aspects of the system.

Included in these factors where savings will be effected are shipping containers, handling and storage costs, ground handling equipment, launching equipment, checkout equipment, pointing and directing radar, radar support

Reliability Definitions, Equations

DEFINITIONS

P_{km} = Prob. of kill per missile

P_{kh} = Prob. of kill given a hit

P_{hr} = Prob. of hit, given a reliable missile

R_s = Reliability of launching support system

R_m = Reliability of missile proper

Missile System Effectiveness, M_e, equal to $P_{km}/R_m = P_{kh} \cdot P_{hr} \cdot R_s$
This is in effect the kill probability of the system for a completely reliable missile.

The number of missiles required (statistically) for one target kill, $M_t = \frac{1}{P_{km}}$

n = number of missiles per salvo

S_{ws} = Savings in weapons systems cost relative to initial situation expressed as proportion of the cost of the squadron's complement of missiles.

N = Savings in weapons system cost per missile saved.

$\frac{\Delta M_t}{M_t}$ = Proportional number of missiles saved for a given increase in missile reliability.

R_m = final missile reliability

R_{mo} = missile reliability after initial checkout

k_o = "normal" amount of checkout equipment

k = final amount of checkout equipment

r = characteristic constant rate of improvement with each doubling of checkout equipment for a given missile.

C = total costs for final checkout

C_o = total costs for "normal" checkout

F_o = first cost for "normal" amount of checkout equipment

O_o = operating and maintenance costs for "normal" amount of checkout equipment

EQUATIONS

$$P_{km} = P_{kh} \cdot P_{hr} \cdot R_s \cdot R_m$$

$$M_t = \frac{1}{P_{km}} = \frac{1}{R_m \cdot M_e}$$

$$M_t = \frac{n}{1 - (1 - P_{km})^n} = \frac{n}{1 - (1 - M_e R_m)^n}$$

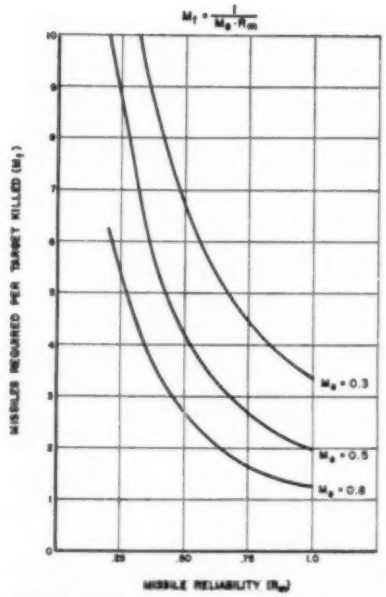
$$\frac{\Delta M_t}{M_t} = \frac{M_e\, n\, (1 - M_e \cdot R_m)^{n-1}}{1 - (1 - M_e \cdot R_m)^n} \Delta R_m$$

$$S_{ws} = \frac{N \Delta M_t}{M_t}$$

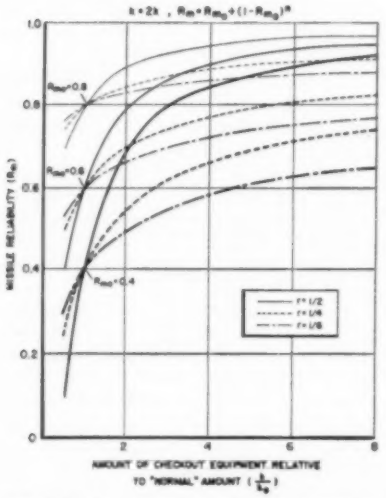
When $k = k_o$, $R_m = R_{mo}$
When $k = 2k_o$, $R_m = R_{mo} + (1 - R_{mo})r$
When $k = 4k_o$, $R_m = R_{mo} + (1 - R_{mo})r + [1 - (1 - R_{mo})\, r]\, r$

$$C = C_o + \frac{k - k_o}{k_o} \qquad (F_o + \frac{O_o}{2})$$

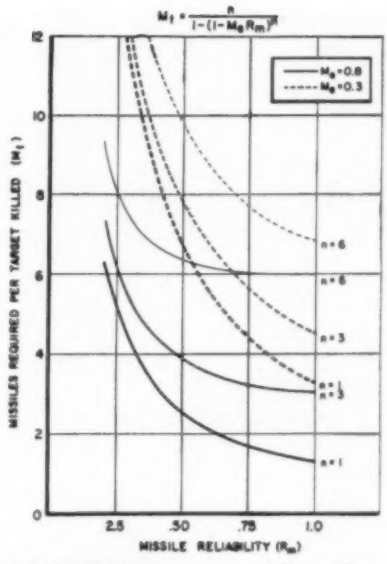
$$\frac{\delta S_{ws} - (C - C_o)}{\delta (\frac{k}{k_o})} = 0$$



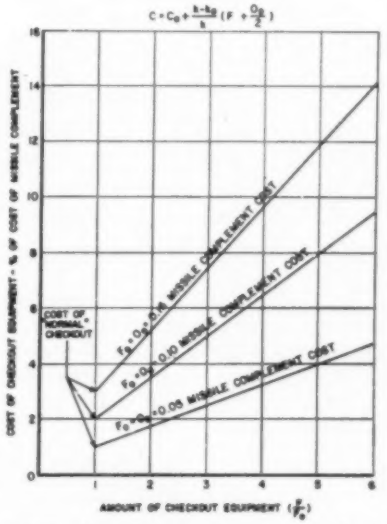
MISSILES required per target killed as function of reliability.



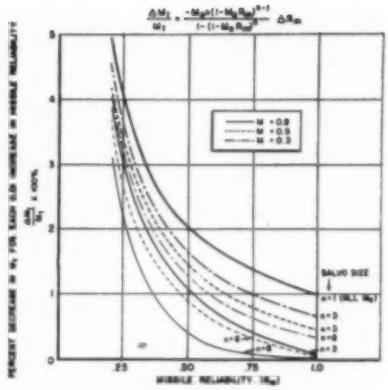
RELIABILITY improvement with increasing amount of checkout.



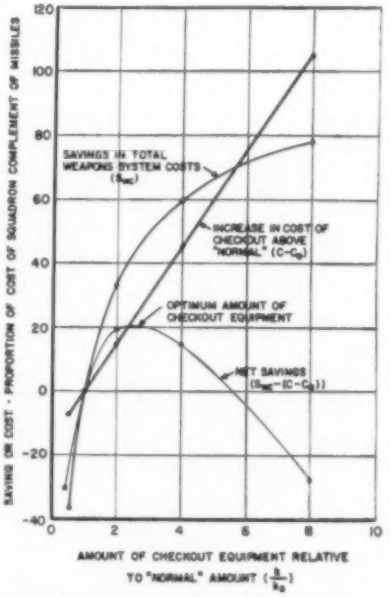
REQUIREMENT to guarantee kill as a function of rounds per salvo.


COST OF CHECKOUT EQUIPMENT - % OF COST OF MISSILE COMPLEMENT
AMOUNT OF CHECKOUT EQUIPMENT ($\frac{I}{I_0}$)
COST OF "NORMAL" CHECKOUT
$f_0 = 0.20$ MISSILE COMPLEMENT COST
$f_0 = 0.10$ MISSILE COMPLEMENT COST
$f_0 = 0.05$ MISSILE COMPLEMENT COST

COST of varying amounts of checkout equipment.



RATE OF CHANGE in missiles required per kill as missile reliability increases.


SAVING OR COST - PROPORTION OF COST OF SQUADRON COMPLEMENT OF MISSILES
SAVINGS IN TOTAL WEAPONS SYSTEM COSTS (S_{wc})
INCREASE IN COST OF CHECKOUT ABOVE "NORMAL" ($C-C_0$)
OPTIMUM AMOUNT OF CHECKOUT EQUIPMENT
NET SAVINGS ($S_{wc}-(C-C_0)$)
AMOUNT OF CHECKOUT EQUIPMENT RELATIVE TO "NORMAL" AMOUNT ($\frac{I}{I_0}$)

OPTIMUM amount of checkout equipment to balance savings, cost.

equipment, spares, facilities, maintenance and handling personnel and personnel training costs.

These overall savings can vary widely with the type of weapon system. For example, Stanly and Tampico say an elimination of 10% in the number of air-to-air missiles required might permit elimination of at least 10% of the aircraft needed, plus all the backup equipment and personnel required for the aircraft.

Balancing Costs

These savings alone can easily exceed several times the cost of the missiles themselves, they say.

On the other hand, eliminating 10% of the missiles of a ground-to-ground weapon system might realize little more than the cost of the eliminated missiles and their spares, this because the remainder of the weapon-system equipment might be needed regardless of a reduction in the number of missiles.

AMP estimated that the total savings per weapon system may range between three and 15 times the cost of the missiles that are eliminated by increasing the reliability through use of more-effective checkout equipment.

Increasing missile reliability through better checkout equipment increases the cost of checkout because more elaborate equipment, than normally used, is required.

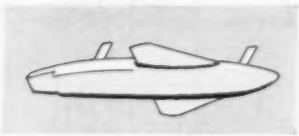
This additional equipment, according to Stanly and Tampico, would provide more thorough checkout of the missile, as follows:

- **Items of relatively high reliability,** such as inertia switches, explosion motors and squibs, not normally checked, would be tested.

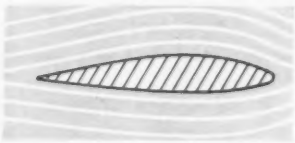
Hence, an additional 5% of missile reliability might be attained, by providing the additional equipment required to check these small and usually reliable devices.

- **Shocking and vibrating the missile** in a manner simulating the launch and flight could reveal a number of weaknesses which could result in missile failure. This procedure would in-

Recent Stroukoff research and development achievements in aircraft landing devices and boundary layer control have opened up vast areas of the world as potential landing fields for heavy aircraft. Pantobase, which has been incorporated in an assault-type transport, for the U. S. Air Force, will contribute materially to the advancement of logistical and troop support techniques.



Pantobase is a landing system which enables an aircraft to land and take off from water, snow, ice, sand and unimproved terrain thus reducing the need for conventional airfields.



BLC-Boundary layer control as developed by Stroukoff increases the effective lift and delays stalling of the wing, thereby reducing required speeds and distances for take-offs and landings.

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volve elaborate checkout equipment and may itself produce some failures which otherwise would not have occurred. In general, however, use of this equipment should promote missile reliability.

• **Increasing the precision of testing** should reduce the probability that missiles with incorrect settings will be passed by the checkout equipment.

Characteristics Set Cost

Relating the cost of additional checkout equipment to the improvement in missile reliability it produces depends upon the characteristics of the individual missile. In general, the lower the initial reliability of the missile, the greater the gains for more-thorough checkout.

Also, the more checkout equipment added, the less the gains from further additions.

Stanly and Tampica say that, if the reliability after checkout with a typical amount of equipment is 70%, then doubling the amount of checkout equipment might result in a 15% improvement in missile reliability.

Checkout Improvement

Doubling the amount of checkout equipment again would result in an estimated improvement in missile reliability of an additional 7½%.

Thus, there is a point of diminishing return, where the cost of the additional checkout equipment would exceed the savings in weapon-system costs resulting from the accompanying improvement in missile reliability.

With additional equipment to attain a more-thorough checkout, an overall saving in weapon-system cost of about 20% is indicated by calculations for a sample missile, according to Stanly and Tampico.

Automatic Checkouts

However, for a specific missile the amount of checkout equipment which is used cannot be accepted as the most economical until a detailed analysis is made.

For today's infant state of the guided missile art it is probable that more, rather than less, checkout equipment usually is justified, Stanly and Tampico say.

An advantage also is seen for making checkout equipment automatic, with go-no-go features. This type of equipment speeds up the checkout process and permits substantial savings in manpower and amount of equipment required.

It also reduces missile wear by lessening the checkout period, thereby reducing the service life time requirements. This also can be translated into lower missile costs.

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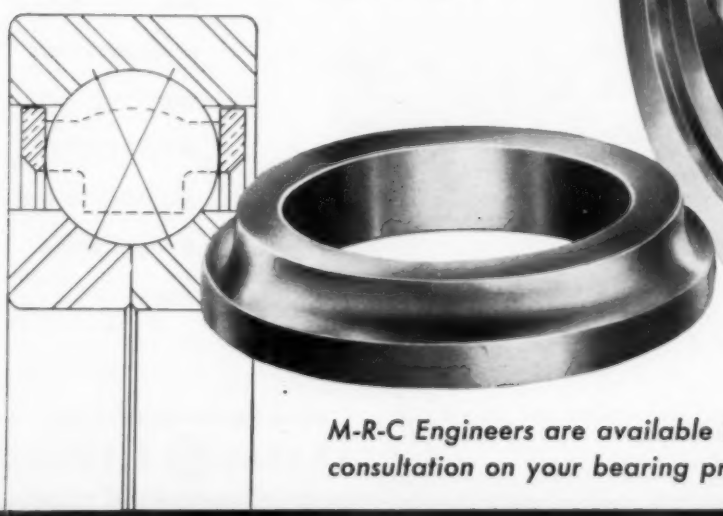

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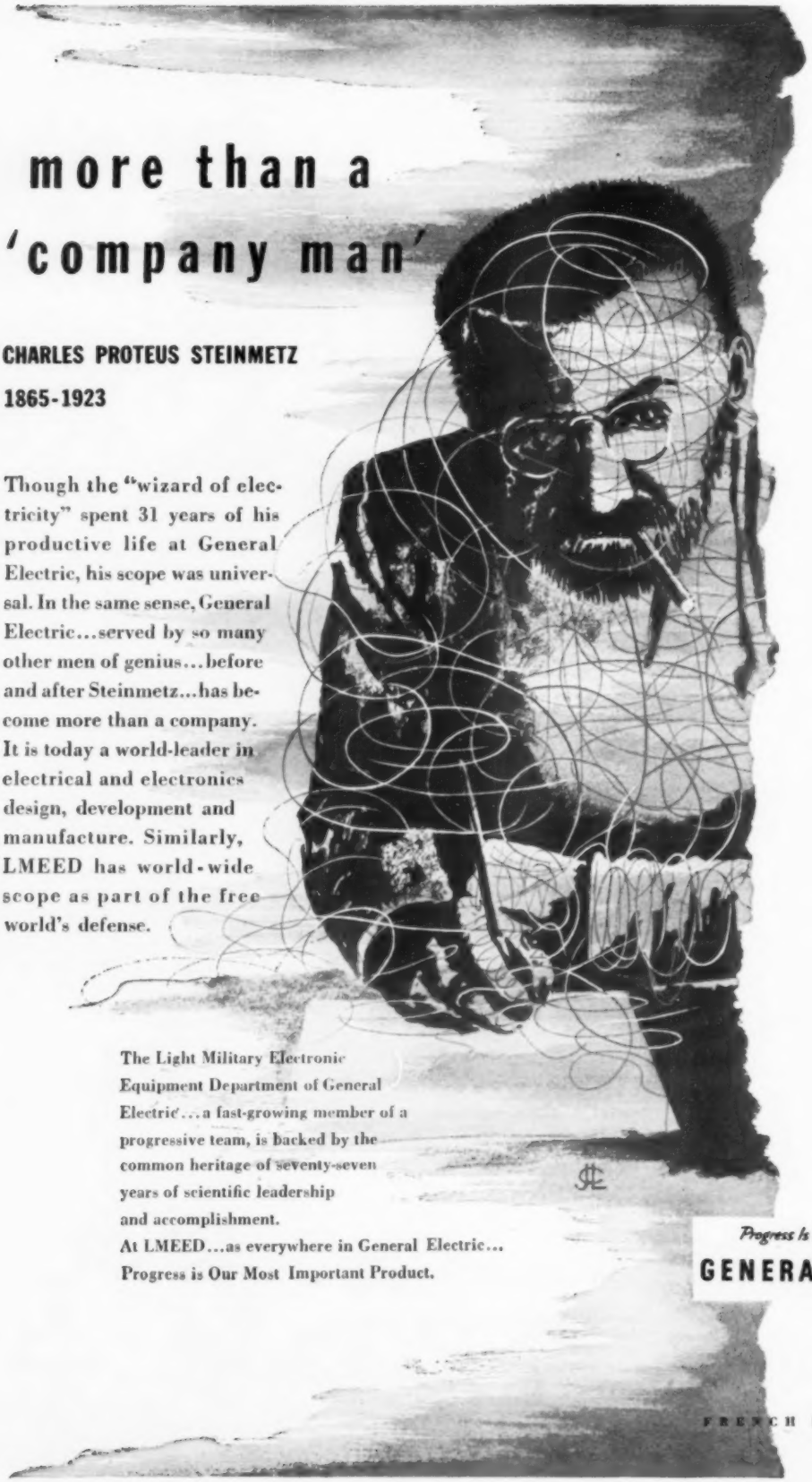

Though the "wizard of electricity" spent 31 years of his productive life at General Electric, his scope was universal. In the same sense, General Electric...served by so many other men of genius...before and after Steinmetz...has become more than a company. It is today a world-leader in electrical and electronics design, development and manufacture. Similarly, LMEED has world-wide scope as part of the free world's defense.

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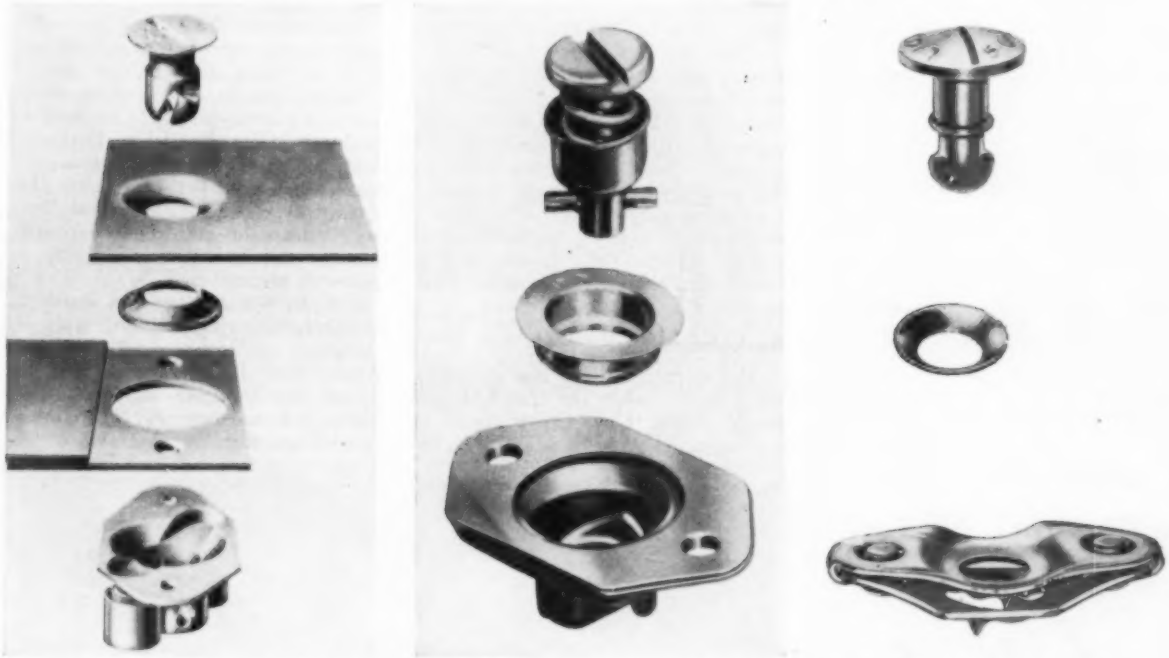


DZUS, CAMLOC AND LION, three of the six fasteners which may be displaced by the standardized Air Force fastener units.

USAF Hopes to Standardize Fasteners

By Robert H. Cushman

Aircraft fastener manufacturers are threatened with a USAF standardization program which would substitute a single Air Force-designed, quick-operating cowling and panel fastener for their respective proprietary types.

The Air Force wants to substitute its Turnloc fastener for the six aircraft-type fasteners now in use—Camloc, Airloc, Dzus-Supersonic, Lion, Scovill and Shakeproof. The Air Materiel Command claims this will reduce the catalogue of fastener variations from 1,049 to 78.

The Turnloc fastener is a long stud type which, in a limited number of stocked lengths, can fit all installations. Basically, it is a fast lead screw with two sides milled flat so that it can be shoved into the receptacle and then quarter-turned to engage and bear up.

Status of Standardization

The studs of other fasteners must be sized for each application, but the Turnloc has enough threaded length to fit a range of installation depths. So far, the Pachmayr Gun Works, Los Angeles, is the only firm producing the Air Force fastener.

The Air Force is now preparing a reply to fastener manufacturers' objections submitted Feb. 27 through the Aircraft Industries Association. An Air Force spokesman last week said the problem has reached "very high levels."

AIA objections to the Turnloc centered around these points:

- **Uncertainty of panel being** fully pulled up even though the Turnloc appears to be fully engaged.
- **Weight of Turnloc is greater** than present types. Calculated weight addition in "a production airplane" was 50 pounds.
- **Timing may be too late.** Because of the current trend toward supersonic aircraft, all contemporary types of fasteners may soon be obsolete anyhow. The NAS547 stressed-panel type fasteners are displacing the MIL-F-5591 fasteners on high-performance aircraft.
- **Reduction of inventories** may not be as great as the Air Force anticipates. This could be especially true in "tight" locations where the extra stud length of a universal fastener could not be tolerated.

History of the Problem

An Air Materiel Command supporter of the Turnloc standardization program says these are some of the usual objections to standardization, that you can't hope to achieve standardization without paying some sort of penalty and stepping on someone's toes.

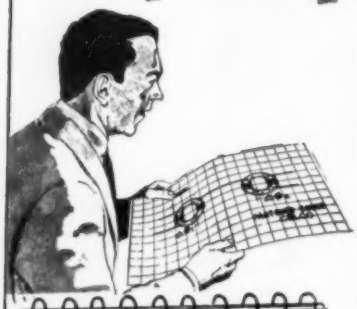
Fastener manufacturers say they learned of this alleged threat of standardization last summer when one of their representatives accidentally came across Air Force Technical Order, T.O. 44H-1-9, dated August 2, which directed that, after the present stocks of fasteners were exhausted, replacement should be made with the Turnloc counterpart.

Although this in itself was limited to Air Force maintenance procedure, the fastener industry felt it was but one step away from the exclusive specification of Turnlocs by USAF for new designs.

Therefore in November 1955, under the sponsorship of AIA's National Aircraft Standards Committee, the six fastener firms sent out questionnaires to airframe fastener users. It was upon the results of these questionnaires, which were said to cover about all of the major airframe companies, that the AIA based its nine-page warning to the Air Force.

In addition to the four previously-mentioned objections to the Turnloc fastener, some of the user comments

when does
$\Delta\phi_1 = \Delta\phi_2$?



when magnetic amplifier cores are matched by Celco

If the hysterisis loops of two toroidal cores shown in the sketch above, are identical in all respects, and identical windings are placed on the cores, then many magnetic amplifiers might operate as predicted, i.e. $\Delta\phi_1$-$\Delta\phi_2$.

However, even if the above assumptions were true, then subsequent handling, impregnation, encapsulation and electrical history of the assembly must be carefully controlled in order to maintain the original performance characteristics. Here at Celco, a considerable amount of development and production experience is available for application to your particular magnetic amplifier problems.

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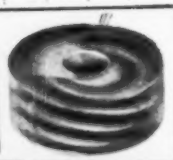

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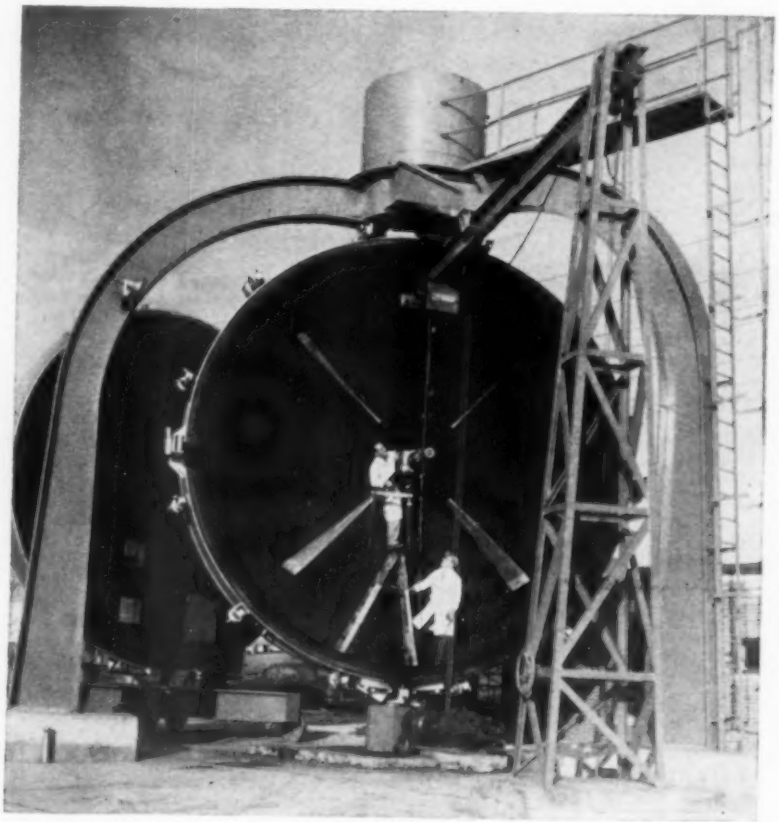
quoted in the AIA letter indicate the Pachmayr fastener is not competitive in performance, cost and availability with other fasteners. Despite the fact that the Turnloc has been available to the aircraft industry for several years, fastener manufacturers say many firms who have evaluated Turnlocs have turned them down in favor of the other types. In reply to some of these objections, W. A. McKinley, assistant to the president of Pachmayr, said the Turnloc as produced by his company now has 50 users, is the production fastener on the Ryan Firebee and is two-to-three times as strong as required by MIL-F-5591.

Background

The dispute actually had its beginnings in 1952 when the 82nd Congress passed Public Law 436 in favor of procurement standardization for the services. Their investigations had led them to believe the lack of standardization was costing the taxpayers excessive defense funds.

There are 1,200,000 line items of supply in the Air Force, and all of these are being subjected to standardization review, according to Don Smith, of the Air Materiel Command's Catalogue of Standardization Division. Fasteners are but one of the many items which can be simplified. He added, however, that the Air Force has no intention of railroading anything through; standardization is strictly a teamwork proposition.

The Turnloc fastener was invented by M. Hatton at the Aircraft Materials Laboratory, Wright Field, during World War II. It is described in Patent No. 2,410,441, dated Nov. 5, 1946, and assigned to the United States Government.



New Propeller Test Stand

A gyroscopic test stand to test propellers under conditions of vibratory stress is a new operational tool at the Propeller Laboratory, Wright Air Development Center of the Air Research and Development Command.

Test propellers are mounted inside a large steel drum, which is evacuated to a simulated altitude of 165,000 ft. The propeller horsepower required is reduced in this vacuum so that props up to 20 ft. in diameter, capable of absorbing as much as 20,000 hp., can be spun with a 60-hp. electric motor.

Superimposed on the normal rotation of the prop is rotation of the entire sealed drum containing the test unit at speeds up to 25 rpm. The gyroscopic action set up by this dual rotation produces vibratory stresses similar to those in flight.

U. K. Direction Gyro Enters U. S. Market

The Allied Instrument Manufacturing Corp., Houston 17, Texas, has been appointed exclusive U. S. distributor of the Model 2-DG gyro direction indicator manufactured by Smith's Aircraft Instruments, Ltd., of England.

Features of the air-driven 2-DG instrument include: low air volume consumption of about one cu./ft. min., about half the volume normally required by air-driven gyros, according to Allied.

The low air use allows the unit to operate at higher ceilings than conventional gyros or permits a dual installation using a single source of vacuum.

The 2-DG is virtually spill-proof, having a full 85 degree freedom of inner gimbal movement in pitch and bank. If the gyro does topple, an integral erecting mechanism restores the instrument to its proper attitude within seconds, eliminating the need for a caging device.

Heading information is presented on a vertical card. An adjustable course pointer, which can be pre-set by pressing in and turning a knob in the center of the instrument's dial, shows student

pilots the presentation they will encounter in operational aircraft.

The 2-DG's mounting centers coincide with those used on standard gyros. Unit's weight is 2 lb., 15 oz.; its maximum recommended vibration amplitude tolerance is 0.004 in.

KLM Planning New Warsaw Route

KLM Royal Dutch Airlines is reported planning to inaugurate a service between Amsterdam and Warsaw in May with two flights a week. . . . KLM reports passenger bookings in January and February were up 30% over the similar 1955 period.

New Canopy Seal

A new, inflatable canopy seal immune to ozone deterioration and capable of retaining room-temperature flexibility at —80F has been installed on the Navy Douglas A4D Skyhawk. The seal was developed by The Connecticut Hard Rubber Co. in cooperation with Douglas Aircraft's El Segundo Division.

The seal, made of silicone rubber, has a non-stick surface (which allows it to come free when a canopy is opened after long periods of closure rather than tearing as organic rubber seals often did) and indefinite shelf life.

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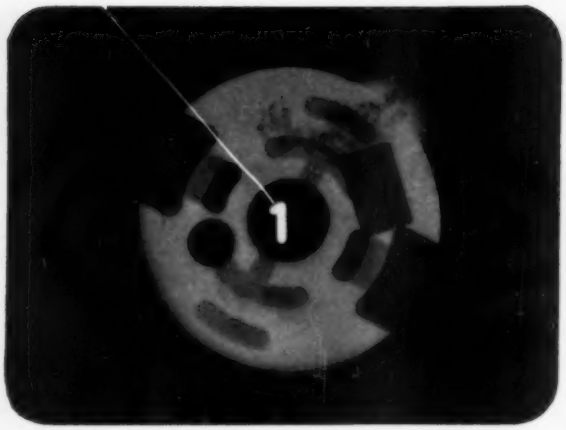
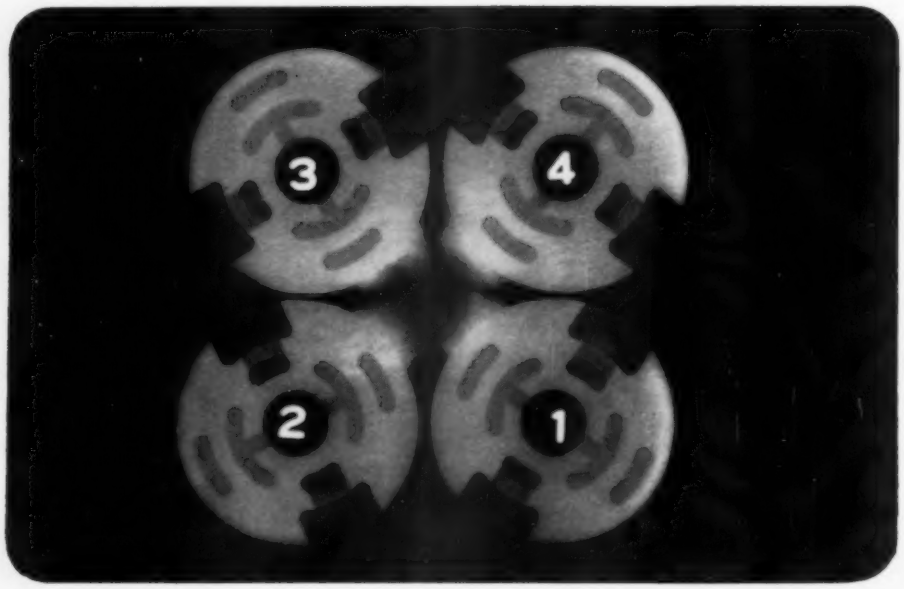


1. Radiography revealed considerable internal shrinkage with original casting technics—suggested a change in gating.

2. Radiography, after a change in the "in gate," showed that there was definite progress in eliminating shrink.



3. Radiography shows the final technic, with the "in gate" further increased in size and a minor redesign to improve progressive solidification, produces a satisfactory casting.

Radiographs courtesy of New York Air Brake Company.

Radiography shows how to correct Shrink

More and more cases like this occur every day. So it's easy to see why progressive suppliers of quality castings make continually greater use of radiography. It points the way to sound production quickly—gives assurance that only high-quality work is delivered.

If you would like to take advantage of radiography in your operations, talk it over with your x-ray dealer. Or write to us for a free copy of "Radiography as a Foundry Tool."

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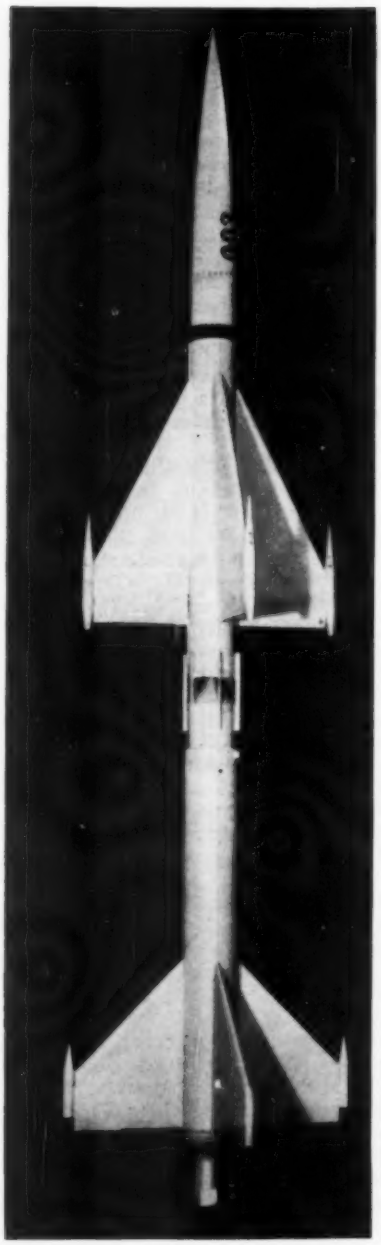

New Swedish Missile

The development of an experimental guided missile intended for the Royal Swedish Air Force and designed to intercept supersonic aircraft, has been announced by the Swedish government. The missile (above) has been under development since 1954. Speeds up to Mach 3 have been reported for the missile, which is expected to reach production by 1959. For the year 1955-56, the Swedish government allocated $700,000 for missile development and $1.2 million for procurement. The 1956-57 budget includes $900,000 for development work and $1.6 million for missile procurement.

Additions Made to Titanium Literature

A major contribution to technical literature on titanium has been made in a series of reports prepared and issued by the Titanium Metallurgical Laboratory of the Battelle Memorial Institute.

A total of 35 comprehensive reports has been prepared at the Laboratory; 20 of these are available to industry on request. The available reports and their numbers are listed below. Requests should be addressed to Titanium Metallurgical Laboratory, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

(7) **Survey of** the Problem of Delayed Cracking in Formed Titanium Parts.
(8) **Principles** and Practical Aspects of Titanium Heat Treatment.
(10) **A Study** of the Air Contamination of Three Titanium Alloys.
(12) **Formability** Tests on Titanium Alloy Sheet.
(13) **Selection of Materials** for High-Temperature Applications in Airframes.
(No number) **Supplement** to TML Report 13.
(15) **Engineering Properties** of Commercial Titanium Alloys.
(18) **Analysis** and Laboratory Examination of Aircraft Parts Which Failed by Delayed Cracking.
(19) **General Summary** of the Physical Metallurgy of Titanium Alloys.
(20) **Effect of Carbon,** Oxygen, and Nitrogen on the Mechanical Properties of Titanium and Titanium Alloys.
(21) **The Diffusion** of Interstitial and Substitutional Elements in Titanium.
(22) **Selective Standardization** and Status of Specifications for Titanium Mill Products.
(24) **The Application** of a New Structural Index to Compare Titanium Alloys With Other Materials on Airframe Structures.
(25) **Beta Transformation** in Titanium Alloys.
(27) **Effect of Hydrogen** on the Properties of Titanium and Titanium Alloys.
(29) **Oxidation of Titanium** and Titanium Alloys.
(30) **Flow Properties,** Deformation Textures and Slip Systems of Titanium and Titanium Alloys.
(31) **Welding to Titanium** and Its Alloys.
(34) **Antigalling Coatings** and Lubricants for Titanium.
(35) **Discussion** of the Design of Riveted and Bolted Joints in Titanium Sheet.

New Use for Film Found by Pan American

Pilots on Pan American World Airways' Pacific routes are being qualified into some airports by studying the approaches and general layout through motion pictures and other training devices rather than actually flying into the fields on checkout runs. The new system, which PanAm estimates will save $40,000 a year in the airline's Pacific-Alaska Division, has been approved by Civil Aeronautics Administration.

Basic feature of the system is the use of wide-angle movies, shot at the airports during approach landing, to familiarize pilots with peculiarities of terrain and special procedures. The training takes place at the division's San Francisco headquarters, with lectures by meterologists and check pilots supplementing the films.

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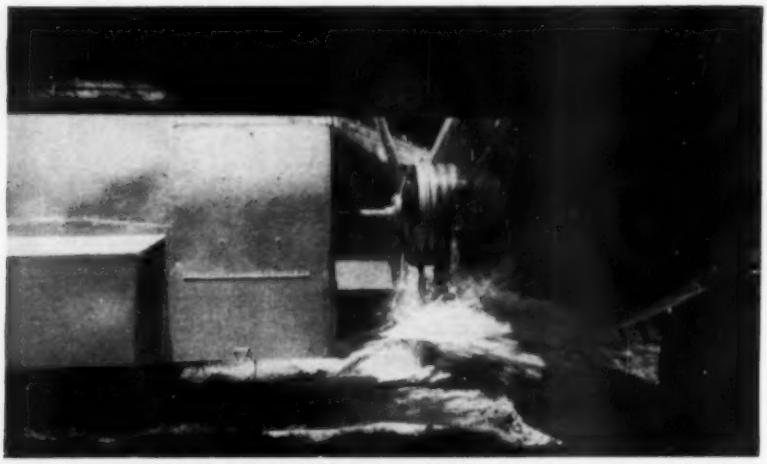
Australia Develops New Rescue Vehicle

AUSTRALIAN RESCUE TENDER carries three-man crew, foam, asbestos, blankets, saw.

APPROACHING FLAMING AIRCRAFT, tender sprays foam, readies saw (circular protrusion).



TREPANNING SAW BEGINS WORK after flames in tender's path are out, cutting hole in fuselage. Three seconds later, the hole, diameter 2 ft. 6 in., provides escape from the aircraft interior.

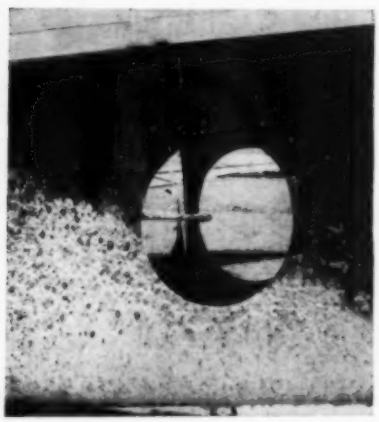
Melbourne—A new airport fire-fighting and rescue vehicle developed by Australia's Department of Civil Aviation can lay a swath of foam to the side of a burning plane and then cut a hole through the fuselage to provide an emergency exit for survivors.

As soon as the hole has been cut, the vehicle swings two 11x18-ft. asbestos blankets into position to protect passengers and crew as they flee the fuel-fed flames. The rescue tender can produce foam spray from a ground sweep and foam or water from a large-capacity nozzle.

A dramatic feature of the new tender is the 2½-ft.-diameter trepanning saw which cuts a hole in the aircraft's metal fuselage. The saw spins at about 400 rpm. to rip into the plane's structure in about three seconds. It can be extended 3 ft. from the truck, and elevated 30 deg. above the horizontal. It incorporates a flange to prevent too-deep penetration into the cabin to avoid injuring persons inside. The cut-out circle usually comes out with the saw, its developers say.

The vehicle's cab is constructed of double-skin steel walls 1½ in. apart, filled with insulating rock wool to protect occupants against outside temperatures of 600C for up to half an hour. Windows are heat-resistant glass. Shutters made of steel, and having transparent mica inserts, serve as additional protection in case of intense heat.

Mounting the engine in the rear protects it from the heat and leaves the front of the cab free for fire-fighting equipment and personnel. The hydraulic ram used to extend and retract the saw is operated from the truck's water pump. An auxiliary 6-in. metal-cutting circular saw with 180 ft. of electric cable is also provided to help free any passengers trapped inside the fuselage.



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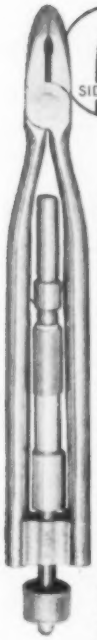

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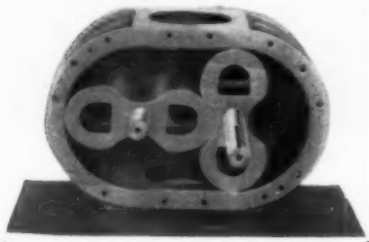

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WHO'S WHERE

(Continued from page 23)

Charles H. Shuff, director of licensee-integrated sales and **J. R. Burns**, director-Electronic and Defense Products Division, Westinghouse Electric International Co., N. Y.

Robert L. Lowry, manager, customer-relations-GEDA (electronic computing) product sales department, Goodyear Aircraft Corp., Akron, Ohio.

L. Stewart Mims, nuclear engineering department, Bell Aircraft Corp., Buffalo, N. Y.

Arthur C. Treece, general manager-plastic department, Chemical and Metallurgical Division, General Electric Co., Decatur, Ill. also, **John L. McMurphy**, manager of a special study-team on the division's insulation businesses.

William P. Kennedy, assistant manager-sales engineering, California (Burbank) Division, Lockheed Aircraft Corp. also, **C. A. Chapman**, project sales engineer for the passenger Constellation project.

Allan Beek, applications manager, Logistics Research, Inc., Redondo Beach, Calif.

Walter F. Ring, project manager, Industrial Acoustics Co., Inc., N. Y.

James P. Malmstrom, general manager, United Aircraft Products, Inc., Dayton, Ohio.

Fred L. Schwab, general sales manager and **Stanley McClean**, works manager, Phillips Control Corp., Joliet, Ill.

William H. Levings, operations assistant to the vice president, Southwest Airways.

Melvin Ehrlich and **Milton Geller**, senior engineers-electronics department, United States Testing Co., Inc., Hoboken, N. J.

Dr. Wallace C. Caldwell to head a new department for expanded research into and production of transistors, Red Bank Division, Bendix Aviation Corp., Eatontown, N. J. Also, **John H. Wyman**, chief engineer for electron tubes.

Rudi Buschmann, military operations research division engineer, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga.

S. J. Pipitone, manager-design analysis department, Goodyear Aircraft Corp., Akron, Ohio.

R. Dixon Speas to serve as management consultant on operating problems and to head a research program relating to the use of jet and turboprop aircraft for Slick Airways.

Air Commodore John Mutch, Air Officer (Administration), Information Branch, Ministry of Supply, England.

George M. Owen, production manager, Taylorcraft, Inc., Conway, Pa.

C. A. Thomas, general manager-sales, Stratoflex, Inc., Ft. Worth, Tex.

Michael S. Dayton, sales manager, Arga Division, Beckman Instruments, Inc., South Pasadena, Calif.

Glen G. Magnuson, sales development manager, United Air Lines and **R. L. Mangold**, cargo sales manager.

Joseph E. McDonald, Jr., military sales staff, Beech Aircraft Corp., Wichita, Kan., assigned to Washington, D. C.

Norman J. Philion, director, travel facilitation, Air Transport Assn., handling activities concerned with cutting red tape in international travel.

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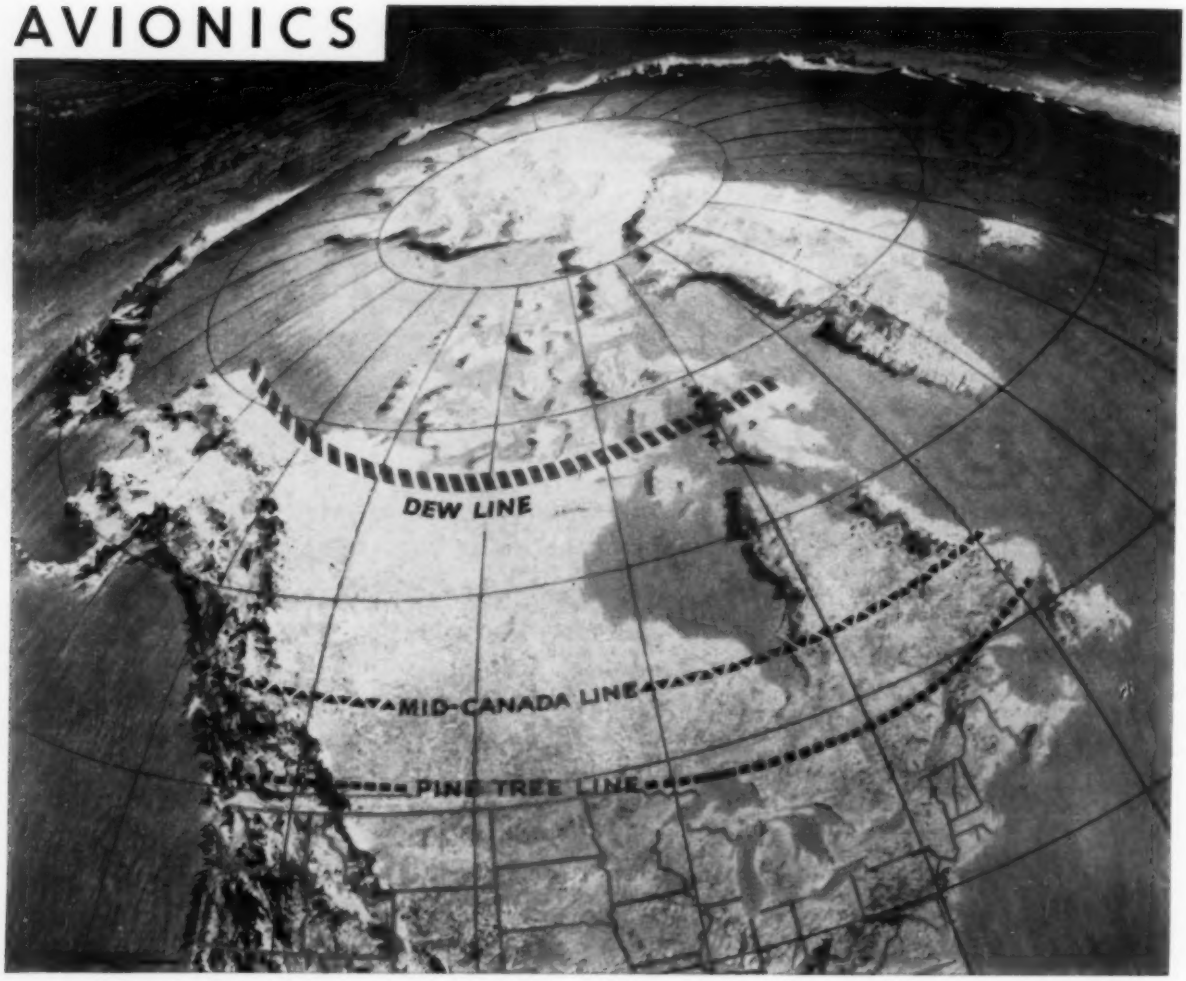


C-124s formed backbone of military airlift which brought heavy equipment to DEW Line.

DEW Line: N

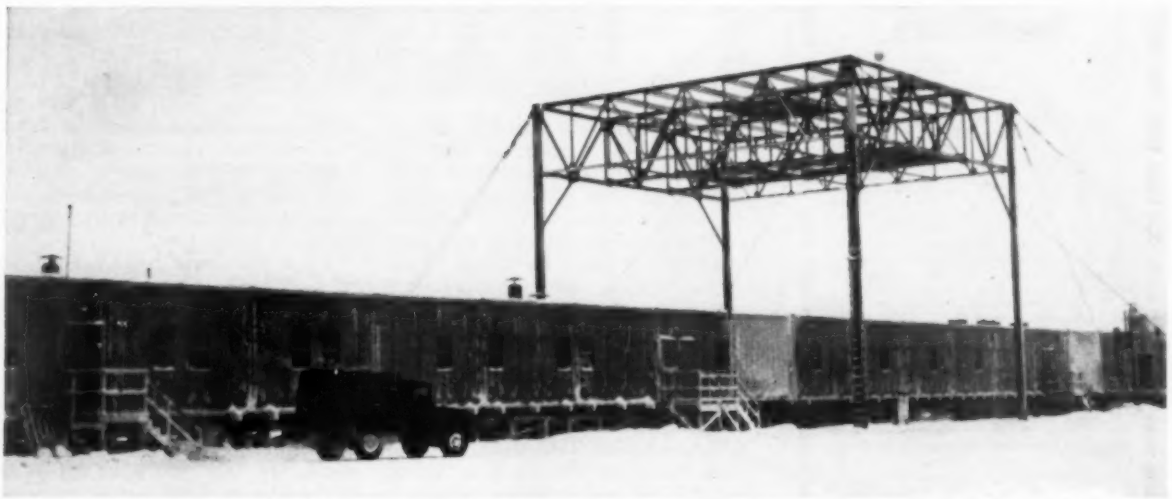
By Philip Klass

North of the Arctic Circle—The construction phase of the Distant Early Warning (DEW) Line is nearing completion. Dozens of radar stations are being built on a 3,000-mile stretch of inhospitable arctic wasteland along the 70th Parallel. When finished by the end of 1957, the DEW Line should provide an extra two or more hours warning of jet-bomber attacks coming over the northern polar region.

A visit to four DEW sites and views of several others from the air, provide impressive evidence that this difficult construction project is over the hump. The USAF says the project is on schedule.

Visitors to the DEW Line, however, are prevented by military security from saying whether installation of radar

SURVEY TEAMS, flown into isolated Arctic to establish DEW radar sites, braved 50-75 below-zero temperatures and 100 mile-hr. winds.



SUPPORTING FRAMEWORK for radar antenna straddles train of modules which will house equipment and personnel at DEW station.

New Security Net Being Forged in Arctic

equipment is under way or will soon begin.

The $400-million project is being financed by the U.S. Running north of the Arctic Circle from Alaska to Baffin Island near Greenland, it is 1,500 miles in advance of the present Pine Tree Line (49th Parallel) and 1,000 miles above the Mid-Canada Line now being installed by Canada on the 55th Parallel.

The earlier warning should provide additional time to:

- **Launch Strategic Air Command** bombers and give them a running start —a major deterrent to any aggressor.
- **Muster air defense forces,** including reserves, enabling them to strike before enemy bombers reach strategic areas.
- **Alert civil populations.**

DEW Line information on hostile aircraft will be "collected, sifted and transmitted" to Alaskan and Northeast Air Defense Commands and to Canadian and U.S. air defense headquarters. The data will then be fed into the new SAGE (Semi-Automatic Ground Environment) computers "where necessary," according to Maj. Gen. James E. Briggs, Assistant USAF Deputy Chief of Staff/Operations. Gen. Briggs indicates that some DEW Line stations will have the capability of controlling interceptors and guided missiles when they become operational within the bounds of DEW Line territory.

The DEW Line will use three types of radar stations:

- **Main,** employing a rotating surveillance radar and including maintenance, re-supply and operational capabilities.
- **Auxiliary,** employing identical rotating radar but lacking the logistics support capability.
- **Intermediate,** employing a non-rotating type radar which puts up an "electronic fence" to fill gaps in the coverage of the rotating radars. This radar is similar to those employed in the Mid-Canada Line.

Basic radar line-of-sight limitations, in combination with the earth's curvature, means that rotating radars would have to be located at approximately 100 mile intervals if coverage down to 1,000-ft. altitude is required. Approximately 60 radar stations—30 main and auxiliary and 30 gap fillers—would be needed on this basis for the DEW line.

Automatic alarm circuits will sound whenever an aircraft penetration image is detected, thus eliminating the tedious monitoring of radar scopes.

A majority of the personnel who will man the stations will be civilians work-

An Engineer Speaks Out...

...about Airborne Amplifiers

One problem which always seems to exist in selecting an airborne amplifier is the DC power requirement . . . a factor that influences the output vs. weight ratio.

Here at Servo Corp., we have airborne amplifiers which require no DC power. Each has a built-in power supply.

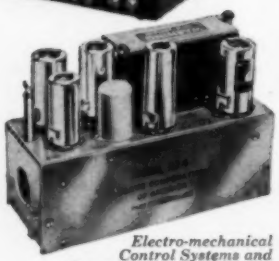
There are three models in our airborne series. Model 1124, for DC input, built to MIL E 5400 specs, has a voltage gain of approximately 25,000. Our low-gain Model 1123 for AC input, also built to MIL E 5400 specs, has an internal negative feedback loop that provides error rate damping in stabilizing position servosystems. Model 1121 accepts two AC and one DC input. It has output vs. weight ratio of 5.1.

We also produce an amplifier for industrial control systems. This is our Model 1120. It has three AC inputs . . . will drive any 10 watt, two phase servo motor . . . and operates either as a position servo or as a velocity servo.

For the *full story* on our amplifiers — dimensions, weights and complete specs — please fill in your name and title in the section below. Attach it to your company letterhead and mail it on to me.

Ted Westover

Chief Control Systems Engineer



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Name .....

Title .....

COMPLETED MODULES: assembled at Pt. Barrow, were hauled to sites by "cat-train."

ing under a few USAF and RCAF officers at the main stations. Gen. Briggs explained:

"As the numbers of people to be supported (in the Arctic) increase, the support effort itself rises in a much steeper ratio.

"For this reason, the people who are to operate these installations must . . . possess the greatest number of combinations of skills which we can find. The outdoor worker must be a bulldozer operator, rigger, high-tension repairman and diesel mechanic. He should be mature, emotionally stable and experienced in this trade. It is obviously uneconomical to have this very specialized category of military personnel where there is no other need for them in our defense establishment."

Federal Electric Corp., a subsidiary of International Telephone & Telegraph, has been selected from among several U. S. and Canadian bidders to man the DEW line. Its personnel will begin training within the near future under supervision of Western Electric Co., a subsidiary of American Telephone and Telegraph Co. Western Electric is prime contractor to USAF on the DEW Line construction.

ECM and ICBM

To the question of whether the DEW Line stations could be jammed by enemy countermeasures, Briggs answered that anti-ECM techniques are being employed in the radar's design wherever their incorporation would not delay DEW Line schedules. Briggs indicated that the very act of jamming is in itself an advance notification of aggressive enemy action, which is what the DEW Line is intended to provide.

Regarding the DEW Line's effectiveness against intercontinental ballistic missiles, Briggs said only that "when they are an immediate threat, we will have to meet it."

Observers familiar with present radars generally concede that greater ranges and better resolutions will be required to meet the ballistic missile threat. However, new and improved radars, communications or other equipment can be substituted for present units if and when they become available.

Arctic Beachheads

Construction of the DEW Line was no brief engagement against the Arctic's 50-75 below zero temperatures. It called for the establishment of permanent radar sites at isolated spots along a barren desert covered by ice and snow for much of the time.

These permanent beachheads had to be built so that men and equipment could live and work efficiently for an indefinite period. This required approximately 180,000 tons of material during 1955, the first year, with perhaps another 125,000 tons slated for this year. The Arctic provided only gravel and water; everything else—housing, food, bulldozers and radar—had to be transported to the sites by airlift, sea-lift, parachute drop, caterpillar-drawn sleds and/or barge.

The USAF and commercial air carriers brought in nearly 50,000 tons of material or some 30% of the first year's supplies.

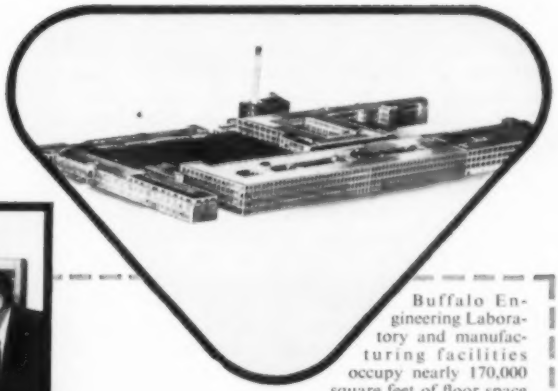
This impressive figure does not fully record the airplane's contribution to the DEW Line project. Without the airlift, work would have been delayed six months in starting because the sea lanes are open only for one-or-two weeks during late August and early September. With the airlift, work could begin early in 1955.

Moreover, because the short arctic construction season runs from May to September, little could have been accomplished until the following May if it had not been for the running start made possible by airlift.

Construction and living needs are difficult to anticipate in the unpredictable Arctic, so one of the airlift's greatest contributions was supplying the daily emergency needs of the construction camps during the arctic winter.

The Douglas C-124 Globemaster, flown by the 18th Air Force, proved it-

The right people with the right facilities produce the right solutions



Buffalo Engineering Laboratory and manufacturing facilities occupy nearly 170,000 square feet of floor space in this industrial center at 175 Great Arrow Ave., Buffalo 7, New York.

Observing measurement of circuit parameters in the Electronic Systems Division's Buffalo Engineering Laboratory. From left: *H. C. Tittle*, Manager—Buffalo Operations; *M. C. Scott*, Manager—Buffalo Engineering Laboratory; *R. W. Ferry*, Assistant Product Engineering Manager and *A. W. Puttick*, Product Engineering Manager.

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Engineered in the Buffalo Engineering Laboratory of Sylvania's Electronic Systems Division, this highly advanced electronic system employs subminiature tubes, transistors, and printed circuits in a package which is itself subminiaturized. Despite its complexity of design and purpose, it is engineered for quantity production in the Division's Buffalo plant.

In all of Sylvania's Electronic Systems Division installations, the right people work with the right facilities, within a sound managerial environment. That is why they have produced the right solutions to a variety of problems, and have made such important contributions in the fields of aviation electronics, guided missiles, countermeasures, communications, radar, computers and control systems. Whether the problem is military or industrial, Sylvania's business is to come up with electronic solutions that are *producible*.

In addition to its Buffalo Engineering Laboratory and manufacturing facilities, the Electronic Systems Division has installations at Waltham, Mass., and Mountain View, Calif., staffed with top-ranking scientists and engineers, and backed by Sylvania's extensive resources in the electronics field.

SYLVANIA IS LOOKING FOR ENTERPRISING ENGINEERS

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Summary of North American Radar Defenses

- **Pine Tree Line:** A basic radar warning and control system extending approximately along the 49th Parallel (U. S.-Canadian Border). The network, now operational was financed jointly by U. S. (two-thirds) and Canada.
- **Mid-Canada Line:** An early warning line extending approximately along the 55th Parallel from Labrador to the Pacific Ocean. Sometimes called the "McGill Fence," it was developed by the Canadian Defense Research Board and McGill University and employs a non-rotating type of radar which in effect creates an "electronic fence" in the air that sounds an alarm when penetrated by an aircraft. The Mid-Canada Line, under construction, is being financed entirely by Canada at a cost of about $200 million.
- **DEW Line:** A distant early warning radar network, extending approximately along the 70th Parallel, from Baffin Island (near Greenland) to Alaska. The DEW Line employs both conventional rotating type surveillance radars and the non-rotating "electronic fences" as gap fillers. The DEW Line, slated to be operational before 1958, will be financed by the U. S. at a cost of more than $400 million.

In addition to these formal radar lines, extensions down both flanks of the continent are under construction, supplemented by radar picket ships at sea, airborne early warning aircraft, and Texas Tower radar stations, now under construction.

self to be a versatile arctic performer in DEW Line operations. (Some 30 members of the Canadian and U. S. press who toured the DEW Line in a C-124 will dispute this. Minor mechanical difficulties caused a two-day delay and forced them to change aircraft twice during the tour. Even the smallest failure looms large when you try to perform maintenance in sub-zero weather without adequate facilities or personnel.)

Globemasters flew more than 700 sorties in the Canadian sectors, bringing in more than 11,000 tons, including 20-ton bulldozers which could not be handled by commercial carriers in smaller C-46s, C-47s and C-54s. Globemasters grossing 168,000 pounds landed and took off from 6,000-ft. landing strips cleared on frozen lakes.

In the summer of 1952, a Defense Department-sponsored study by the Massachusetts Institute of Technology's Lincoln Laboratory and other scientific groups, concluded that the-then existing radar defenses were incapable of preventing a crippling nuclear attack on the nation.

Out of this study came the recommendation that a radar network be constructed in the far north to provide additional warning time. Questions of arctic-construction feasibility and cost were raised.

Estimates of cost ranged from $50 million to more than $1 billion, according to Gen. Briggs.

Still another basic problem was reliable communications to link such a DEW Line with U. S. and Canadian air defense centers. The high frequency (HF) band, normally used for long-distance communications, is extremely unreliable in the Arctic, suffering frequent black-outs from sun spots, Aurora Borealis and other atmospheric disturbances.

Technological Breakthrough

Alternatives—thousands of miles of land lines or microwave stations at 30-mile intervals—were economically, if not physically, impossible.

Fortunately, a "technological breakthrough" in communications, called "scatter communications," in 1951-52 by scientists at the Lincoln Laboratory, Air Force Cambridge Research Center

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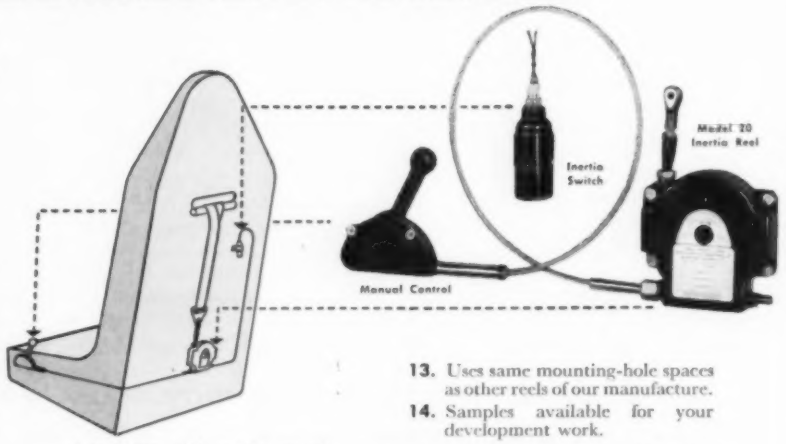

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3. **Powerful heightfinding antenna,** FPS-6XW1, developed by G.E. for USAF in 1949, was an advancement in long-range detection.
4. **Giant shipboard search antenna,** largest in use today, was G-E developed and produced for Navy early-warning ships.
5. **Long-range search antennas** (FPS-7) were designed and built by G.E. using advanced construction techniques.
6. **One of the first combination antennas** (allows both search and elevation detection), the Navy's SPS-8 was designed and produced to give a precise beam pattern.

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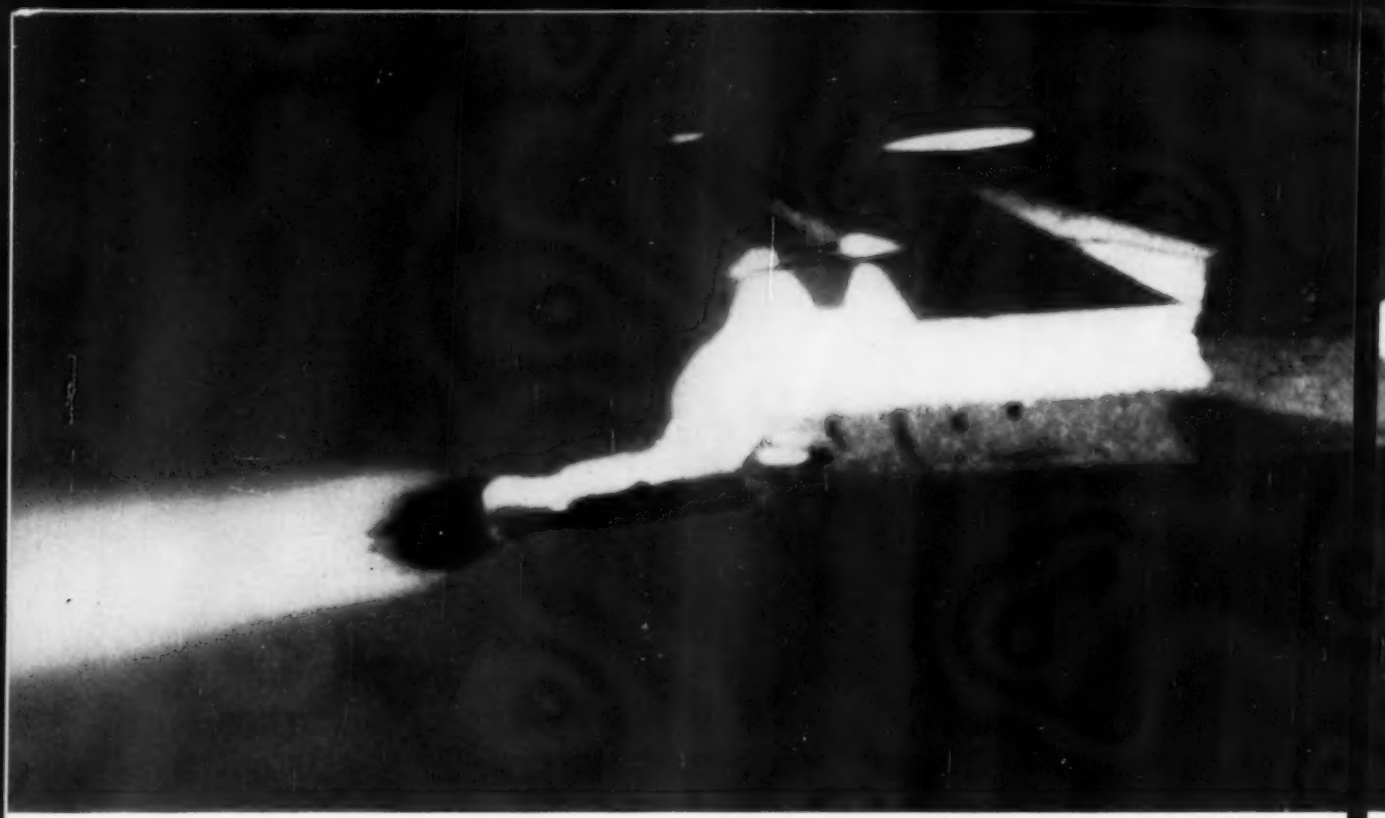

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Typical of AVIATION WEEK's staff of experienced engineer writers is Avionics Editor Philip J. Klass, author of the exclusive report on this new missile guidance system. Mr. Klass graduated in Electrical Engineering from Iowa State College in 1941, joined General Electric, and spent the next ten years in phases of GE's avionics activities including fire control, flight control, navigation, and instrumentation joining AVIATION WEEK in 1952. Mr. Klass is a member of the American Institute of Electrical Engineers Institute of Radio Engineers (member of IRE professional groups on Aeronautical and Navigational Electronics, Communications Systems, Electronic Computers, Radio Telemetry and Remote Control, Component Parts, and Management), Aviation Writers Association, and Delta Sigma Rho.

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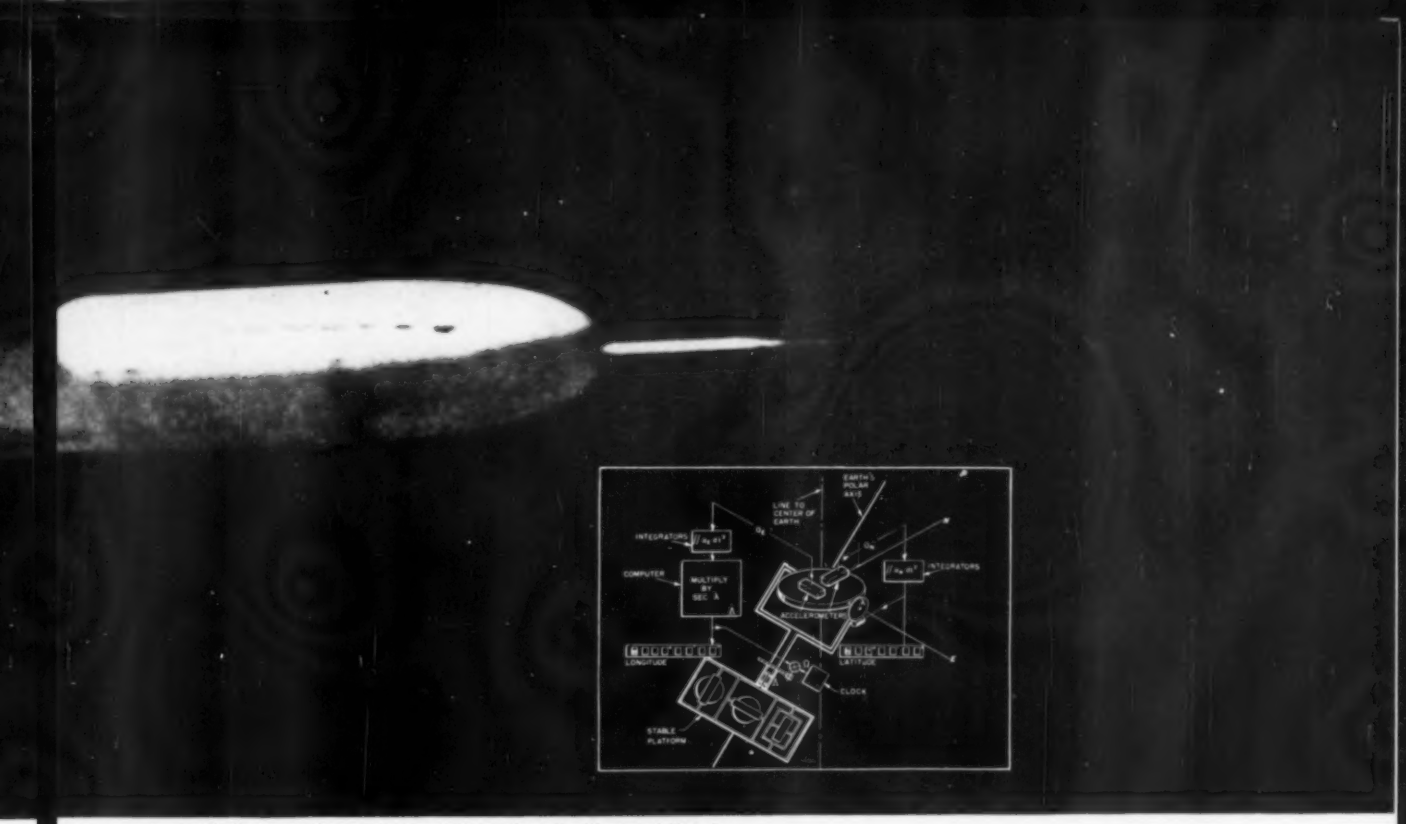

intercontinental ballistic missile as well as missiles such as the illustrated Matador.

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DEW Line Avionics Suppliers

Principal firms contributing to the DEW Line program as sub-contractors to Western Electric:

Bell Telephone Laboratories, American Machine and Foundry, Blaw Knox, Lincoln Laboratory, Collins Radio Co., Radio Corporation of America, Raytheon and Motorola. Collins reportedly is supplying scatter communications equipment, Raytheon some of the radar. Motorola is believed to be furnishing microwave link equipment.

and National Bureau of Standards, provided the solution. It involved the use of very and ultra-high frequencies (VHF, UHF) which, though not affected by atmospheric disturbances, were previously thought to be limited to line-of-sight transmission distances.

Scientists established that by going to vastly higher transmitter powers, large high-gain antennas and extremely sensitive receivers, enough VHF and UHF energy could be bounced or scattered off the ionosphere and troposphere to extend useable range of VHF to 1,200 miles and the range of UHF to about 350 miles.

These scatter techniques opened the way to using UHF to interconnect individual stations laterally across the DEW Line and VHF communications to link the DEW Line with U.S. and Canadian air defense centers.

Experimental DEW

To test the feasibility of the DEW-Line concept, gain first-hand knowledge of arctic construction problems and evaluate the reliability of the new scatter communications, the Air Force late in 1952 asked Western Electric Co. to build an experimental segment of the line in Alaska.

Calling in specialists from 17 Bell System operating companies, a Canadian affiliate, the Bell Telephone Laboratories for systems engineering, Western Electric launched a crash program to construct and put the experimental segment into operation within a year.

Engineering and procurement went on in parallel because there was less than three months to assemble the necessary materials for airlift to the sites and only two additional months for rounding up the remainder of the supplies for sea lift.

Prototype stations were built in Northwestern Illinois to provide a training ground for technical personnel before they left for the Arctic as well as to check out the design of the radar and communications equipment.

These sites also provided informa-

tion on the number and type of component failures which might be expected, enabling the company to better plan the number and type of spare parts which would be needed at the Alaskan sites.

During this same period (spring of 1953) the company made low-level aerial reconnaissance flights along the 70th Parallel, from Alaska to Baffin Island in the east, studied aerial photographs made available by the Royal Canadian Air Force and analyzed the sea and air-lift supply problems.

Feasibility Fixed

The Alaskan segment was completed in November 1953. Evaluation tests and area survey studies indicated that the full 3,000-mile network was feasible. However, the Alaskan sites pointed up certain changes in station design better suited to arctic existence.

The original Alaskan sites were laid out with a main corridor from which arms extended at right angles. Drifting snow piled up at the corners of the arms and the main corridor. The new DEW Line sites are laid out with all units (modules) installed in one or two in-line "trains" pointed in the direction of the prevailing wind. The modules are mounted on stilt-like platforms which permit snow to blow under them without piling up. The radar antennas will be mounted on a steel structure which straddles the module train.

Because a major portion of the stations would be located on Canadian soil, arrangements had to be worked out between the two governments. This was accomplished late in 1954. Western Electric was again asked to assume prime contractor responsibility for erecting the DEW Line. This responsibility included engineering, procurement, transportation, construction, installation and final operational testing and training of DEW Line operating personnel.

Western Electric set up a Defense Projects Division in New York, where the USAF also established its DEW Line Project Office. The Project Office included representatives from the Air Materiel Command, Air Defense Command, Northeast Air Command, Alaskan Air Command and the RCAF.

The 3,000-mile line was broken down into three sections—Alaskan, Central (Western Canada) and Eastern (Canada). Actual construction was subcontracted to private contractors, a combination of U.S. firms for the Alaskan sectors and Canadian companies for the other areas.

Before construction could begin, each site location had to be carefully pinpointed so that radar would have an "unobstructed view" of the area it was to cover, preferably on high ground.

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the blustery Arctic in ski-equipped planes during the winter of 1954-55. They landed, and lived, in areas so remote and desolate that most had never known even the hardy Eskimo.

Bootstrap Operation

Close on the heels of the siting teams came the first construction groups, also by ski-planes, to measure the thickness of the ice for suitability as a landing strip. A small strip was cleared to permit C-47s and C-46s, flown by commercial carriers, to come in with a small 7-ton D-4 "cat." (In some cases, the D-4 "cats" were paradropped by C-119s into the sites.)

In a bootstrap type operation, the small "cats" were used to clear 6,000 foot runways on the ice which permitted the C-124s to come in bringing larger 20-ton D-8 "cats." The arrival of the big D-8s was welcome because strong arctic winds frequently blew snow back on the ice strips about as fast as the smaller "cats" could push it away.

Once a strip was secured, personnel and materials were flown in, and camp construction began. Communications equipment and meager navigation aids in the form of a low-frequency radio beacon followed. (The story is told of an airlift pilot who returned to his base unable to locate the construction site because he could not tune in its radio beacon. The beacon was part of the cargo he was carrying to the site.)

Modular Construction

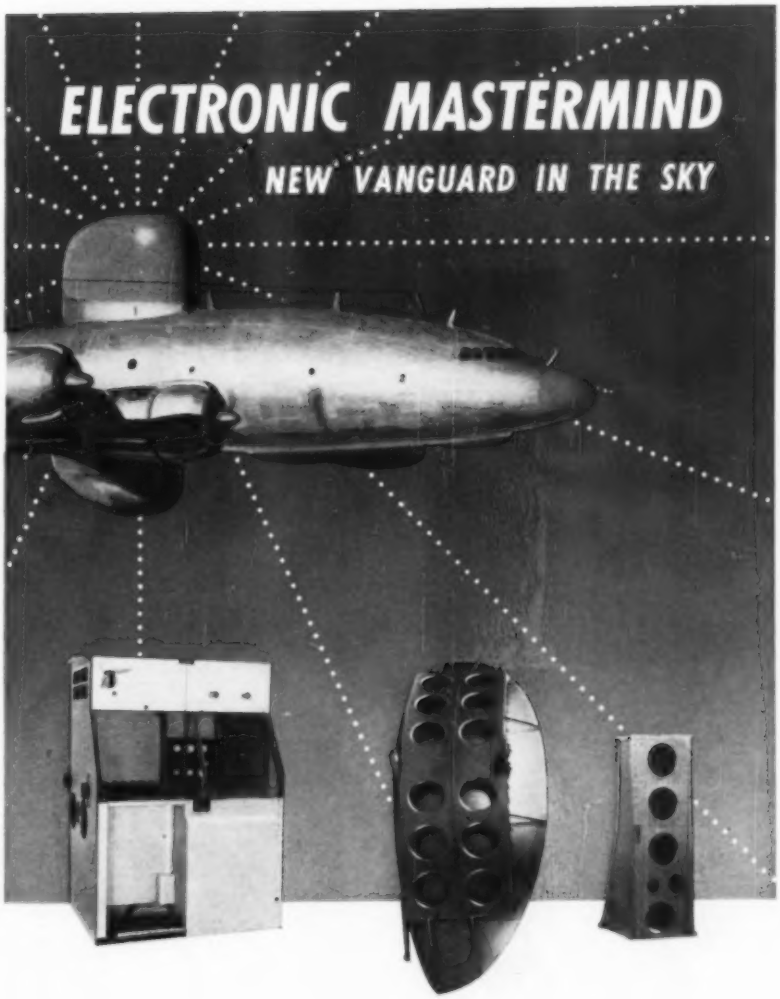
The DEW Line stations are constructed from standard prefabricated 10-foot high modules measuring 16 x 28 ft., lined up to form the "train." The intermediate (gap filler) site consists of a train of five modules; the auxiliary site consist of a train of about 25 modules, while the main stations consist of two 25-module trains with a connecting crosswalk forming an "H" shaped structure.

Some modules are fitted as living quarters for DEW Line operating personnel. Others will house the radar, communications and power generating equipment. Still others provide kitchen and recreational facilities.

Because of the shortage of water, particularly during the winter, fire is much-feared in the Arctic. The modules therefore are constructed from insulated panels which are painted with fire-resistant paint.

The modules also have elaborate automatic fire detection and extinguishing systems, both carbon dioxide and water sprinkler.

Metal "fire-break" modules are installed at key points along the train to isolate the power generation, electronic equipment and living quarter segments from one another.



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Soviet Avionics, Part II:

Soviets Can Match U.S. Avionics Within the Next Three Years

The Soviets will pull abreast of Western technology in the field of electronics within the next three years.

This view of a top German scientist is based upon conversations with a dozen German electronics engineers who recently returned to the West after 10 years in the USSR and upon his own observations from "across-the-border" of the Soviet world.

The scientist, for obvious reasons, has requested anonymity. For the purposes of this article he will be referred to as "Dr. Braun."

The fact that the Russians have returned practically all German electronic scientists, as they earlier had done with German rocket and aeronautical experts, indicates the Reds believe they have nothing further to learn from them. This is understandable since the Russians kept the German scientists isolated from new Red advances so that the state of the German scientists' know-how, in a number of fields, is limited to the pre-1945 period.

No Reluctance to Copy

The Russians have shown no reluctance to copy Western and U.S. electronic equipment designs, despite their recognized native competence in many scientific areas. However, like the Japanese before them, they do not stop with copying.

Dr. Braun has been told that the Soviets "always have working models of the latest U.S. equipment." He reports that the Russians have built and presently are testing a U. S. Tacan navigation system, one of our more recent developments.

This in itself is not too surprising since Tacan equipment has been in limited production for at least three years, and full design details were disclosed at a Government sponsored symposium last November.

How Do They Get It

The Russians have several ways of obtaining the latest electronic equipment and/or design practices, Dr. Braun reports. Among them:

• **Espionage.** Through misguided idealists, or paid espionage, the Reds gain much electronic design information. Dr. Braun cites the case of the executive of a large Western industrial firm whose private chauffeur turned out to be a graduate engineer employed by the Soviets.

• **Buying through neutral nations.** It is not unusual for a West German electronic manufacturer to receive nearly simultaneous letters from Sweden, Italy and Switzerland, each asking for a quotation on identical quantities of the same piece of equipment. The Reds also try to buy directly. Recently a West German manufacturer of electronic test equipment turned down a single Russian order which would have taken the firm's entire output of instruments for the next two years.

• **Technical and trade publications.** The Russians have set up a centralized technical intelligence group, Dr. Braun reports, consisting of a few special academies which carefully scrutinize all technical information appearing in the Western technical and trade publications. Such information is then disseminated to Russian engineering groups which have need for it. Despite security censorship and deletions from technical articles, Dr. Braun believes that Red scientists are able to "read between the lines" and piece together the missing technology.

However, the Russians also recognize the importance of cross-pollenization of technical ideas. In the electronics and communications field alone, they have about two dozen publications, according to Dr. Braun. This approximates the number of similar publications in the U.S.

Red Components Lag

The most serious chink in Russia's electronic armor is the inferior quality of their components, Dr. Braun reports. This suggests that the Russian Air Force is in for a major reliability problem in its avionics equipment. Poor quality results from the Soviet's failure to master techniques for mass production of components, which has brought about the extremely high standards found in the U.S.

West European electronic components also generally fall short of U. S. standards, Dr. Braun says. His explanation for this is that the limited market afforded within a small country's boundaries is not sufficient to justify setting up elaborate component manufacturing facilities. Western Europe does not have the hundreds of small firms, such as those found in the U. S., which specialize in one or more types of com-

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Type 1445 Machmeter. USAF Type A-2B. Mach Range 0.5 to 1.5. —1,000′ to +50,000′ altitude.

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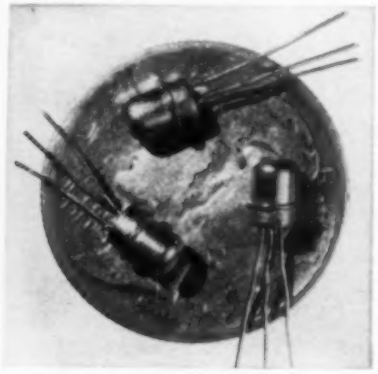
ponents. Instead, most German electronic equipment makers also manufacture most of the components which they use.

Extremely Pessimistic

Russian technological gains in the field of electronics, like those in aviation and other fields, are "a very serious threat," Dr. Braun believes. Based upon continuing Russian efforts to buy precision electronic instruments on the outside, Dr. Braun concludes that the Reds have not yet pulled abreast of Western technology in this field. The quality of electronic equipment turned out in East Germany, Dr. Braun reports, for Soviet use is not very good.

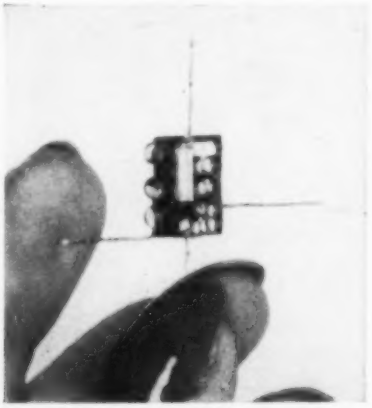
However, in the face of the tremendous number of engineers, scientists and technicians which the Reds are turning out, Dr. Braun fears that whatever lead the West now enjoys in the electronic field will not last long.

The serious shortage of engineers and scientists which is plaguing the U.S. also is a major problem in West



Tiniest Transistor

World's smallest transistor, Philco Type M-1, is so tiny that 20 of them can be placed on a dime. The PNP alloy-junction transistor comes in a welded hermetically sealed case and reportedly can withstand 20,000 G's. Using three of the midgets, Philco built a thumbnail-sized audio amplifier (lower foto) which delivers 80 db. gain.



Germany and Europe. The solution offered by Dr. Braun is a familiar one —better pay for engineers, greater professional prestige and a bigger investment in technical schools and faculties.

(This is the second of two articles on the progress of Soviet Avionics.)

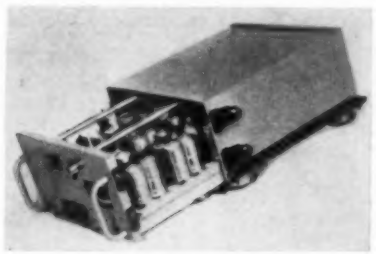
Expansions, Changes In Avionics Industry

Sprague Electric Co., North Adams, Mass., will shortly begin construction of a new 20,000-sq. ft. plant at Concord, N. H., for the manufacture of surface-barrier transistors. The plant is expected to be in production by this fall and to employ about 200 people. Sprague will make the transistors under license with Philco.

Other recently announced expansions in the avionics industry include:

• **International Resistance Co.**, Philadelphia, manufacturer of components, announces its merger with three of its wholly owned subsidiary companies: Hycor Co., Inc., Hycor Sales Co. of California, and Ircal Industries. All three have been transferred to a new facility at 12970 Bradley Ave., Sylmar, Los Angeles County, Calif., and will be operated under the name of Hycor Division of International Resistance Co. William I. Elliott heads the new IRC division.

• **Radio Corp. of America** has established a flight laboratory at New Castle County Airport in Delaware, for testing RCA airborne avionics equipment and ground radar systems. The new RCA facility is near the company's defense production and design centers at Camden and Moorestown, N. J. Charles L. Sharp, veteran test pilot and acronautical engineer, will head the new flight laboratory.



Airborne FM

Airborne FM two-way radio, Model 400-12/24, is available in three versions covering the 25-54 mc., 72-76 mc. or 144-174 mc. bands. Transmitter puts out 20 to 30 watts. Standard model provides single channel operation, with two channels available if desired. The set weighs only 20 lb., not including antenna or speaker. Communications Company, Inc., Coral Gables, Fla.

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AMPHENOL is actively engaged in current miniaturization programs: new Micro-Ribbons are the latest result. Other contributions are Subminax RF connectors and Miniature AN-type connectors. All are considerable engineering feats for all represent a *reduction in size and an increase in reliability.*

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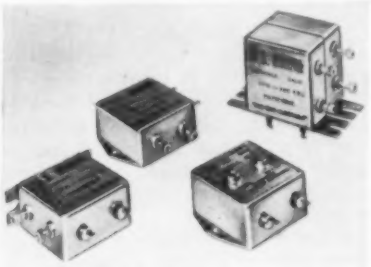
NEW AVIONIC PRODUCTS

Components & Devices

• **Adjustable precision capacitor,** Model B, a polystyrene unit which can be trim-matched to within 0.01%, has an adjustment range of 2½% of rated capacitance. Drift stability reportedly is better than 0.05% per year, and tem-



perature coefficient is −50 ppm./deg.C. Insulation resistance is 2 meg-megohms/mfd. Adjustable capacitors are available in variety of sizes, values and mounting arrangements. U. S. Electronics Development Corp., 1323 Airway, Glendale 1, Calif.

• **Servo amplifier,** Model 1124, small, lightweight unit for airborne use, has voltage gain of 25,000. The amplifier has a built-in pre-amp, power supply, and operates from 115 v., 400 cps. Input can be either a single d.c. signal or the difference between two such input signals. Output will drive any 115 v., 400 cps. motor rated 8 watts or less. Bulletin TDS-1120-4 gives full specs. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.

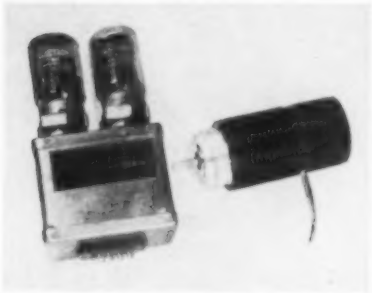
• **Miniature plug-in capacitors,** called Crys-Caps, designed for use with printed circuit boards, come in hermetically sealed cans with working voltages of 50 to 500 v. d.c., in capacitance values of

0.001 to 1.0 mfd., and with tolerances of 1 to 20%. Mylar is used as electrostatic core material. U. S. Electronics Development Corp., 1323 Airway, Glendale 1, Calif.

• **A.C. generator,** Type PG-3323, a permanent magnet unit with high output for its size and weight, delivers 24 va. per phase, 0.33 power factor lagging at 400 cycles, when driven at 12,000

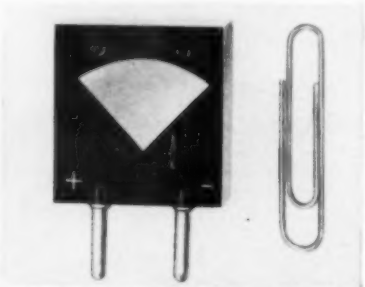
rpm. Device can be supplied as single, two, or three-phase generator. Harmonic distortion is under 5%.

• **Regulated a.c. motor,** 400-cycle induction type and associated control, for use with film, tape, chart and other types of transport mechanisms requiring torque of the order of 5 oz. in., maintains any selected speed between



300 and 16,000 rpm. within 1%, regardless of load or variations in line voltage or frequency. Calibrated dial permits accurate pre-selection of motor speed. WacLine, Inc., 35 So. St. Clair St., Dayton 2, Ohio.

• **Miniature silicon photo cell,** Type P-100, measuring 1 in. square x ⅛ in. thick, can operate at temperatures up



to 150C. National Fabricated Products Div. of Hoffman Electronics Corp., 2650 West Belden Ave., Chicago 47, Ill.

• **High linearity precision potentiometer,** Model MD20, a 10-turn pot provides linearity of 0.01% or better if required. Unit measures 2 in. in diameter, is available in resistance values of 1,000 to 100,000 ohms, with welded taps if desired. Litton Industries, Components Div., 336 No. Foothill Rd., Beverly Hills, Calif., or 215 So. Fulton Ave., Mt. Vernon, N. Y.

Laboratory Equipment

• **Sine wave generator,** Model 1200, generates pure sinusoids from 1 cps. to 1 mc., in six decade ranges. Distortion is less than 0.1%, with output signal of 0 to 8 v., over frequency range. Low output impedance of 600 ohms is independent of amplitude control. Device

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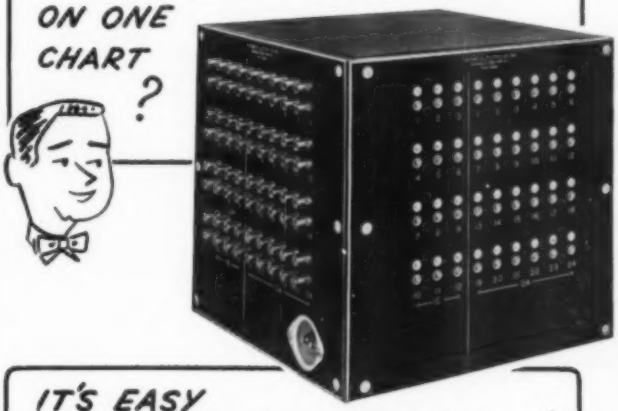

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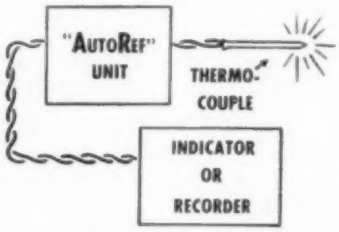
A typical unit of 36 circuits (illustrated) measures 12"x12"x12" and weighs 25 lbs. Case-type and capacity can be modified, however, to meet specific needs. For example, the "AutoRef" is also available for standard relay-rack mounting. In any operation requiring multiple recording of temperatures and other conditions these "AutoRef" Cold-Junction Units set new standards of convenience and efficiency without loss of accuracy.



Typical Application Circuit

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• **Variable delay line,** adjustable in increments of 0.04 millimicroseconds up to 1 microsecond, has rise time of 0.08 microseconds maximum, and frequency response from 0 to 4.5 mc. Data sheet No. 54-74 describes the new Helidel delay line. Helipot Corp., 916 Meridian Ave., So. Pasadena, Calif.

• **Portable audio oscillator,** Model 201C, covering frequency range of 20 cps to 20 kc., in three bands, offers calibration accuracy of 1% and frequency stability of 2% or 0.2 cps, with full range frequency response of ±1 db. Distortion is less than 0.5% from 50 cps. to 20 kc. at 1 watt output, less than 1% from 20 cps. to 20 kc. at 3 watts. Oscillator is priced at $225 f.o.b. factory. Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, Calif.

• **Radio interference-field intensity measuring equipment,** Type NM-40A, is commercial equivalent of Navy Type AN/URM-41. Device, which is tunable over frequency range of 30 cps. to 15 kc., can be used to determine source and magniture of radiated and conducted interference. Device also can perform as a sensitive harmonic wave analyzer, frequency-selective voltmeter in the audio spectrum, acoustic or vibration analyzer (when used with suitable transducers), or for measurement and analysis of hum, noise and modulation present on a CW signal. Electric and magnetic field strength measurements can be made also. Stoddart Aircraft Radio, Inc., 6644 Santa Monica Blvd., Hollywood 37, Calif.

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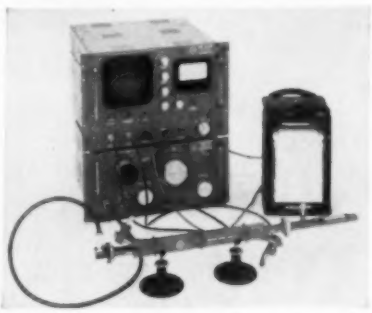
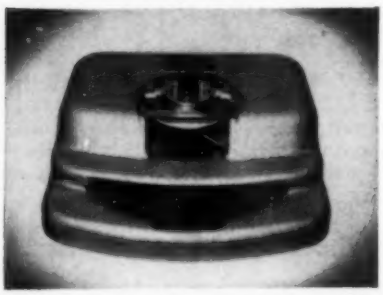


adjustable center frequency, over the operating range of 8.5 to 9.6 kmc. Device includes a built-in oscilloscope and direct-reading meter. Color Television Inc., 913 San Carlos Ave., San Carlos, Calif.

Production Line Testers

• **Radar range, range-rate calibrator,** Model 312, provides simulated target for rapid calibration of range tracking circuits. Unit provides pulse repetition rates of 100 to 10,000 pps., range calibration up to 50,000 yards, and range rate up to 1,500 knots. Missouri Research Laboratories, Inc., 2109 Locust St., St. Louis 3, Mo.

• **Electro-mechanical angle indicator** can be used to measure mechanical and electrical angles of pots, switches, resolvers and similar components. Vernier



scale permits reading angle to within 0.1 degree. Waters Manufacturing, Inc., P. O. Box 368, So. Sudbury, Mass.

• **High resistance megohmmeter,** Model L-7, can check resistance of capacitors

and insulating materials up to 50 megmegohms, with continuously variable test voltage of 100 to 600 v. d.c. Indicating meter has logarithmic response. Device operates from 115 v., 60 cps., costs $325. Industrial Instruments, Inc., Cedar Grove, N. J.

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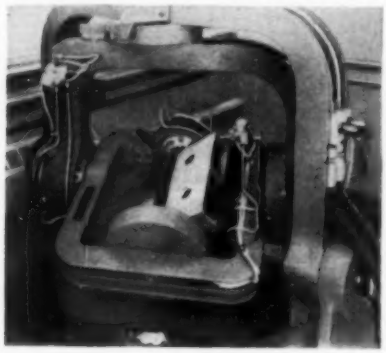
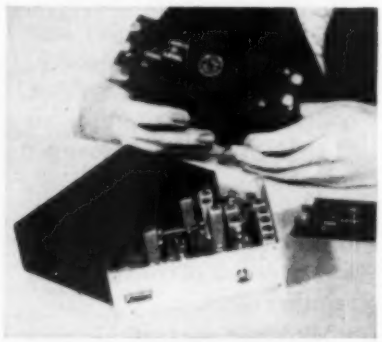
• **Three-axis flight simulator,** suitable for use with an analog computer, simulates the flight conditions of high-performance aircraft in pitch, roll and yaw.

Device can provide roll axis acceleration of up to 40,000 deg/sec.² and maximum velocity of 250 deg./sec. Maximum pitch axis acceleration is 20,000 deg./sec.² and maximum velocity is 150 deg./sec. Maximum yaw acceleration is 8,000 deg./sec.² and velocity is 125 deg./sec. Maximum roll, pitch, and yaw displacements are ±120 deg., ±90 deg., and ±90 deg., respectively. Device operates from 60 cycle power. Color Television Inc., 913 E. San Carlos Ave., San Carlos, Calif.





Tiny Marker Beacon

Miniature transistorized marker beacon receiver, weighs only 1¼ lb., and consumes only ½ watt of power. New receiver, developed by Radio Corp. of America for military, business and airline aircraft, is slated for production later this year. Unit is designed for operation at altitudes up to 40,000 ft., over temperature range of −65F to 160F, and measures only 2 x 4 x 5 in.

Power Supplies

• **Regulated 28-v. d.c.,** Model MR2432-100XA, delivers 100 amp. of adjustable 24 to 32-v. power, regulated to within ½% over complete voltage range. Ripple is 1% rms., and response time is 0.2 seconds or better. Power supply uses magnetic amplifiers throughout, and operates from three-phase, 60-cycle, 208, 230, or 460-v. power. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

• **30 kv. d.c.** can provide more than 30 kw. of power with less than 0.05% ripple. Output voltage is continuously variable from zero and is motor controlled.

Unit operates from 3-phase, 208-v., 50/60-cps. power. Levinthal Electronic Products, Inc., 2727 Fair Oaks Ave., Redwood City, Calif.

• **Regulated d.c.,** Model EM-117, provides output which is continuously adjustable between 2 and 300 v. d.c., up to 5 amps., with regulation of 1% or better. Ripple is 0.2% rms., with recovery time of 0.2 seconds. Magnetic amplifiers are used in the power supply. Input power is 115 v., 60 cps. Engineered Magnetics Co., 11818 Teale St., Culver City, Calif.

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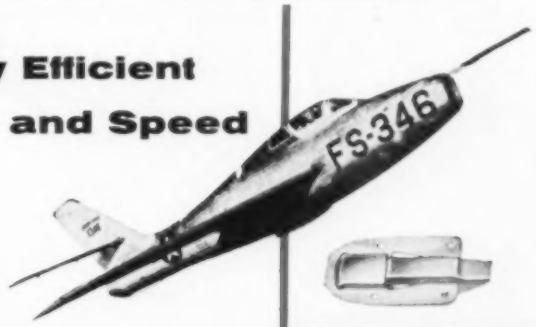
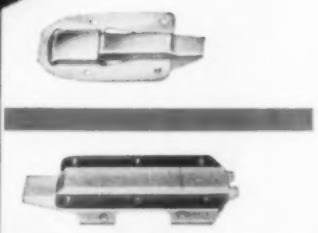


REPUBLIC AVIATION THUNDERSTREAK



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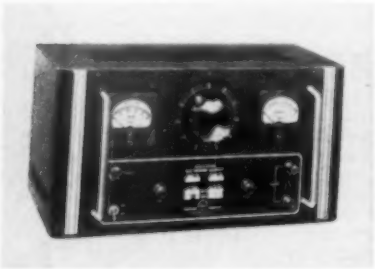


5 amp. Unit conforms to MIL-E-7894.

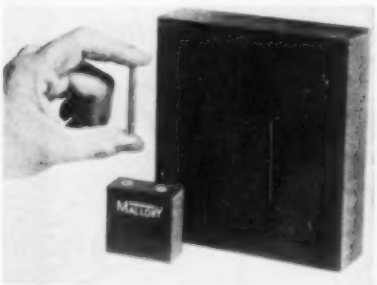
KM75 mounts in a standard 19-in. rack and occupies 8.75-in. panel height. It is also available as a bench unit, designated KM75B.

Opad Electric Co., 69 Murray St., New York 7, N. Y.

Battery Contains No Water

Solid-state battery generates voltage by the difference in contact potential between two conductors in contact with a solid electrolyte. It is expected to have a shelf life of at least 10 years.

A unit only 1 cu. in. in volume is



said to be capable of providing 200 v., and it holds stable voltage over a temperature range of –65F to 165F. Present capacities fall in the micro-ampere range, but development is underway to provide higher current ratings.

P. R. Mallory Co., Inc., Battery Division, N. Tarrytown, N. Y.

Solenoid-operated Shutoff

Designed for aircraft, weapon and missile applications, a d.c. solenoid-operated pneumatic shutoff valve, Model 21A, is available in normally open or closed versions with or without manual over-ride.

Important features of the unit are a

fully statically balanced valve and sealing members of stainless steel, Teflon and media nylon. Pressure ranges for the Model 21A run to 3,000 psi.; temperature range is –65F to +275F; current drain is 1.5 amp. maximum at 30 v. d.c.; voltage range is 18-30 v. d.c. continuous duty.

National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif.

High-Flow Valve

A new line of 3,000 psi., three-way hydraulic selector valves which can handle high fluid flows, is available from Aircraft Products Co.

The lightweight, solenoid-operated units handle flows 85% higher than conventional models, according to the company. This is accomplished by incorporating a fully balanced poppet and designing the internal configuration for minimum dynamic flow effect. Fluid flow between any two ports can be reversed without disturbance.

Valve is furnished in Series 6000 for ¼ and ⅜-in. tubing (these will handle up to 6 gpm.), and Series 6050 for ½ and ¾-in.

Both series meet specification MIL-V-5529A and operate at temperatures ranging from –65F to 160F.

Address: 300 Church Road, Bridgeport, Pa.

Liquid Oxygen Gage

An electronic liquid oxygen quantity gage uses a capacitor-type sensing unit in the oxygen container with a self-balancing bridge network that measures and indicates quantity. The only moving parts are in the motor.

The unit is designed to work on 115 v., 400 cycles. The amplifier section of

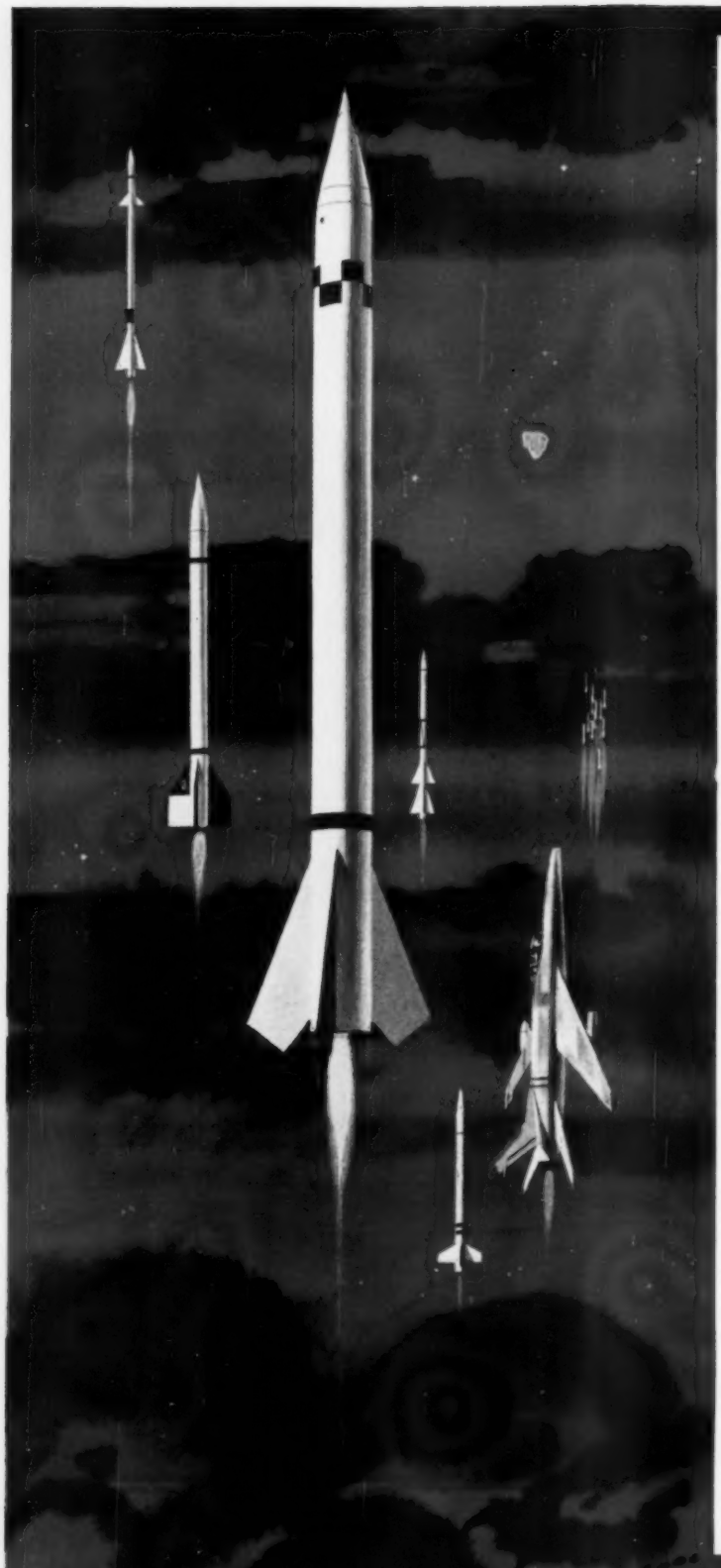
the self-balancing bridge can be supplied with either vacuum tubes or transistors.

For missile applications, the indicator motor can drive an auxiliary potentiometer instead of a pointer, permitting telemetering of liquid oxygen quantity or other liquid gas quantity intelligence to the ground to determine consumption.

Liquidometer Corp., Skillman Ave. & 36th St., Long Island City, N. Y.

Motors Have Overrun Control

Constant-speed oil-hydraulic motors, for use in aircraft systems having operating pressures to 3,000 psi., features an



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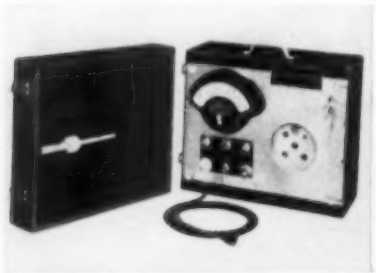
integral anti-overrun flow control to prevent runway action or overspeeding of the motor in event of cavitation. Motor overloading is also prevented by metering of inlet and return oil. Flow control also provides constant-speed drive for either direction of motor rotation.

The control valve can be furnished for Vickers aircraft hydraulic motors handling up to 150 ft. lb. of torque. **Vickers, Inc., Detroit 32, Mich.**

ALSO ON THE MARKET

Miniature straight-through solenoid valve is available in a variety of fittings, normally opened or closed, for continuous duty on either a.c. or d.c.; 2.2 w., 30 psi. or 30 in. hg.—Cedar Engineering, Inc., 5806 W. 36th St., Minneapolis 16, Minn.

Cohrlastic HT 655 and HT 666, silicone rubber compounds, have increased tensile and tear strengths and elongation properties for molded and extruded parts. HT 655 is designed for high temperature work and will remain flexible at minus 65F. HT 666 has low temperature flexibility at minus 100F.—Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.



Thermal switch tester with built-in heat block (portable test equipment) has been developed to test and adjust overheat detectors, thermal switches, fire-warning indicators, etc. Temperature range: 200 - 1,000F. Meter assembly is designed to act as both a temperature indicator and heat block controller.—Ram Meter, Inc., 1100 Hilton Rd., Detroit 20, Mich.

IMP, mobile radiotelephone, is designed for installation on materials handling trucks, messenger vehicles and transportation units. Unit has a range of 1-5 miles, and can operate on 6 v. d.c., 12 v. d.c., or 117 v. a.c. Weight: 21 lb.; approximate size: 12 x 8 x 5 in. —Kaar Engineering Corp., 2900 Middlefield Rd., Palo Alto, Calif.

Model 158-5490, 8-channel oscillographic recording system is housed in mobile, 46-in. cabinet, for recording analog computer outputs or other types

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of recording.–Sanborn Co., Industrial Division, 195 Massachusetts Ave., Cambridge 39, Mass.

Aerial photo interpretation kit, for use in analyzing aerial photographs, contains all necessary devices for viewing and precise measuring.–Gordon Enterprises, North Hollywood, Calif.

Miniature indicator light Model 1F has two independently wired bulbs to show four different conditions. Dual lamp

indicator is 1.8 in. long and mounts in a 0.75-in.-diameter hole in panels up to ¼ in thick.–Eldema Corp., 9844 Remer St., El Monte, Calif.

G-20 precision potentiometers, are available with radial or rear extension turret terminals; linearity is 0.5 or better; and power rating is 1.5 w. at 65C. (derated to 0 at 150C.).–Gamewell Co., Newton Upper Falls 64, Mass.

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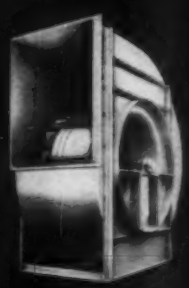

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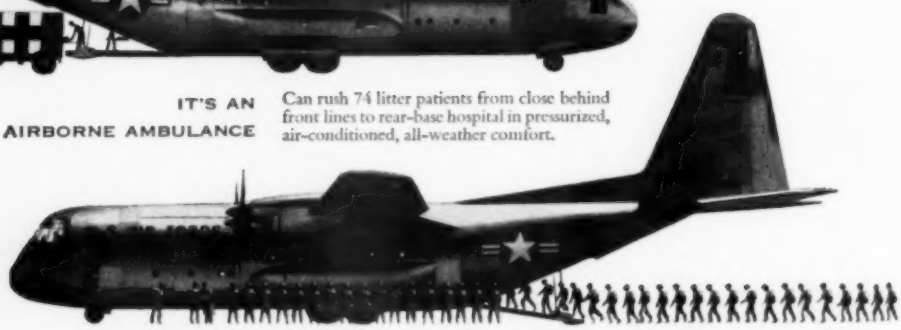

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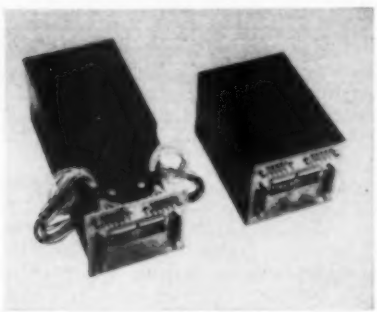
tion. Contact rating is maximum 5 amp. or 500 v., maximum 250 v.a.—C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

Size 11 geared servo motor is a combination of Size 11 precision servo motor and precision gear train of same diameter, 1.062 in.; length up to 2.219 in. Unit designed for 400-cycle operation at either 115 or 26 v.; can be wound for other voltages on either phase. Gear train utilizes miniature precision ball bearings throughout.—Components Division, G-M Laboratories, Inc., 4300 North Knox Ave., Chicago 41, Ill.

Hydraulic-type direct-reading force gage is designed to measure the force between electrodes on spot welding machines, or between rolls on roll welders; also makes compressive tests. Its use enables duplication of correct electrode pressure for any job without numerous sample welds. Units' 3-½-in. gage reads directly in lb., requires no conversion chart, and is accurate to 1%.—Webster Instrument, Inc., 11856 Mississippi Ave., Los Angeles 25, Calif.

Hermetically sealed airborne sampling switch has up to 6 poles and 12 nonshorting channels per pole, with integral special design 400-cycle hysteresis synchronous motor and starting capacitor. Unit is available with variations in



numbers of poles and channels, with or without hermetic sealing; approximate size is 2⅞ x 3 x 4⅞ in.—General Devices, Inc., P.O. Box 253, Princeton, N. J.

Radiflo is a non-destructive, atomic energy leak detection system for testing hermetically sealed parts and containers. System provides a nominal sensitivity of 1 c.c. per 500 years; may be used in any leak detection problem. Large numbers of parts can be radiated or immersed and cleaned simultaneously.—Reed-Curtis Nuclear Industries, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif.

Fluoroflex-T R3800, factory-preformed Teflon aircraft hose assemblies, save weight and space and eliminate need for special elbows. Lines are perma-

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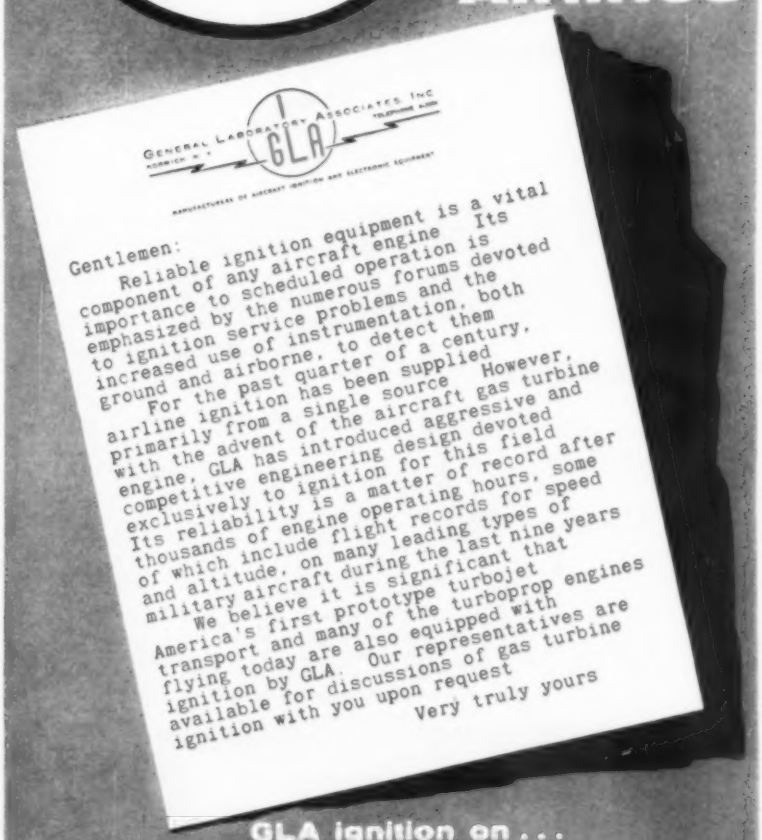
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60-cycle a.c. servo motor has been developed in several models. Unit is 1¼ in. diameter x 2¼ in. long. Both 2-pole and 4-pole machines are available with either hysteresis or induction-type rotors.–Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

WHAT'S NEW

Telling the Market

Installation techniques, size ranges and applications of **PIP push inserts,** Bulletin No. 731, Heli-Coil Corp., Danbury, Conn. . . . Data for computing load ratings of **miniature ball bearings,** an engineering study, Engineering Dept., Miniature Precision Bearings, Inc., Keene, N. H. . . . Listing of **design, engineering, test and production facilities,** (aeronautical and related projects), brochure, All American Engineering Co., Wilmington, Del. . . . Uses of **Tap-Lok inserts,** booklet, Groov-Pin Corp., 1125 Hendricks Causeway, Ridgefield, N. J.

Technical specifications of **unplasticized rigid polyvinyl chloride blowers,** Bulletin 102, Industrial Plastic Fabricators Inc., Norwood, Mass. . . . Features, construction and applications of **straight-through disconnect** which seals instantly at both ends, folder. Eastern Aircraft Products Corp., 229 River St., Orange, N. J. . . . Application of ultrasonic **Reflectoscope for non-destructive testing** of products and equipment, bulletin No. 50-105, Sperry Products, Inc., Danbury, Conn.

Performance, features and details of the **Piper Apache,** brochure, Piper Aircraft Corp., Lock Haven, Pa. . . . Analysis of engineering features and operating advantages of **custom-engineered fan clutches,** Technical Report 6214, Warner Electric Brake & Clutch Co., Beloit, Wis. . . . Description of Atkins **anti-collision or relative danger light,** booklet,–William Atkins, 1910 E. Shakopee Rd., Minneapolis 20, Minn.

Cored forgings, announcing availability of specification cored forgings in aluminum and other non-ferrous metals, brochure, Weatherhead Co., Aviation Division, Antwerp, Ohio. . . . **Stainless steel hose clamps** for aircraft, folder, Form No. AH-156, Wittek Manufacturing Co., 4305-37 West 24th Place, Chicago 23, Ill. . . . **Applications of investment casting** process, booklet, Arwood Precision Casting Corp., 56 Washington St., Brooklyn 1, N. Y.

Postive static sealing metal O-rings for aircraft, brochure, Advanced Products Co., P. O. Box 75, North Haven, Conn. . . . **Narco Sapphire 1016 VHF communications system,** Bulletin No. 38, National Aeronautical Corp., Ambler, Pa. . . . Data sheet on series 6000 line of **3-way solenoid operated selector valves** for 3,000-psi. hydraulic service, Aircraft Products Co., 300 Church Road, Bridgeport, Pa.

Illustrated manufacturing techniques of sales **model aircraft** produced for manufacturers, catalog, Topping Models, Inc., 517 First National Tower, Akron 8, Ohio. . . . **Approved aircraft pulleys,** folder, Formica Co., 4628 Spring Grove Ave., Cincinnati 32, Ohio.

Solutions to **problems of corrosion, heat, impact or abrasion** in manufacturing processes, booklet, Electric Steel Foundry Co., 2141 N.W. 25th Ave., Portland 10, Ore. . . . **Facilities for producing custom-made rubber parts** and components, brochure, Goshen Rubber Co., Inc., Goshen, Ind. . . . **The Plant**

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Engineers' Guide to Machinery Mounting. Vibration and Noise Control, Bulletin K6A, Korfund Co., Inc., 48-03D 32nd Place, Long Island City 1, N. Y.

Powerpaks and Hand Pumps, describing control centers for hydraulic systems, Bulletin No. 102, Electrol Inc., Kingston, N. Y. . . . Presentation of **expanded scale a.c. voltmeters** for panel mounting, bulletin, Arga Division, Beckman Instruments, Inc., 220 Pasadena Ave., South Pasadena, Calif. . . . Details of operation and manufacturing capacities; extrusion design suggestions, Kaiser's Halethorpe, Md., **heavy press plant,** booklet, Kaiser Aluminum's Industrial Service Division-PR 356, 1924 Broadway, Oakland 12, Calif.

Publications Received

• **Aircraft Gas Turbines**—by C. W. Smith—Pub. by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 448 pp. $8.75.

A rounded picture of the aircraft gas turbine power plant, containing information on component design, calculation, analysis, and prediction of performance, correction of test results, and presentation of performance data. Much of the material applies to stationary as well as to aircraft power plants.

• **Ucon Fluids and Lubricants**—Pub. by and available through Carbide and Carbon Chemicals Co., a Division of Union Carbide and Carbon Corp., 30 E. 42nd St., New Yok 17, N. Y. 52 pp.

Properties, applications, and characteristics of Ucon fluids and lubricants.

• **Helicopter Navigation Requirements**—by F. Dorn Barclay and Gordon S. Wiley—Prepared for Bendix Aviation Corp. by Stanford Research Institute and available through Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif. 97 pp.

Presents the probable requirements for aids to the navigation of helicopters operating in the period 1958-1965.

• **11 Ways to Save Drafting Time**—Pub. by Frederick Post Co., 3666 N. Avondale Ave., Chicago 18, Ill. Available without charge upon request.

Presents 11 ways to use intermediates to make quick modifications of drawings without changing the original.

• **Proceedings of the RETMA Symposium on Automation**—Pub. by Engineering Publishers, GPO Box 1151, New York 1, N. Y. 114 pp., 132 ill., paper bound, $5.00.

The papers presented at the Symposium on Automation sponsored by the Engineering Department of the Radio-Electronics-Television Manufacturers Association.

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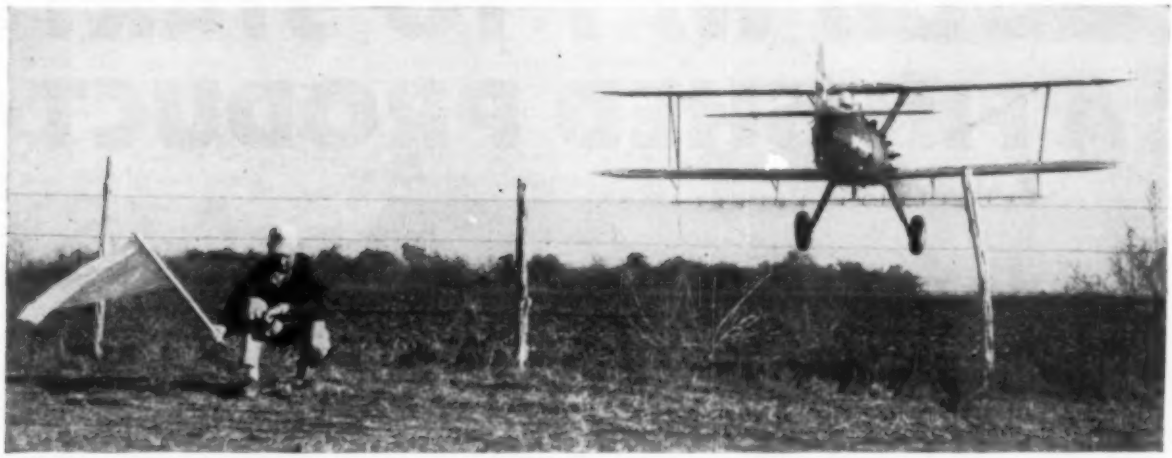

STUDENT makes typical aerial applicator pass over practice field as flagman (foreground) ducks, flags and times the turn.

PRE-FLIGHT BRIEFING is given by Prof. Fred. Weick (left).

INSTRUCTOR Gale Hanson (second from left) outlines day's work.

Colleges Help Solve Spray-Pilot Dearth

By Erwin J. Bulban

College Station, Tex.—U. S. agricultural colleges are entering into the battle to help aerial applicators lick the critical shortage of trained spray/dust pilots.

The payoff of a long-standing effort by applicators to develop interest in the necessity for a build-up of schooled personnel began here late last year with the graduation of the first class of pilots by the Texas Agricultural & Mechanical College System under a curricula developed by the Texas Aerial Applicators Assn.; Gale Hanson, Civil Aeronautics Administration agricultural and industrial operations specialist, and Fred E. Weick, designer of the Ercoupe and now a professor in Texas A&M's aeronautical engineering department.

Now, there are now firm indications that four or five additional colleges will offer courses on the Texas A&M pattern this year.

Weick said A&M also plans to offer a second course starting about Nov. 6, and will repeat the courses at approximately the same time each succeeding year. He added that an additional course, starting just after the first of each year, also is under consideration. Applications, he said, have been received from prospective students from all over the world, including the Soviet Union.

The Texas A&M course stresses safety. Intensive schooling in the biological elements of aerial application, care and handling of equipment, customer relations and legal aspects also are covered.

Industry Support

Numerous sources cooperated in supplying equipment, facilities and personnel to get the training program off the ground.

Texas Aerial Applicators Assn. donated $500; National Insurance Underwriters, St. Louis, Mo., gave $200; Aero Agricultural Service, Inc., Alice, Tex., provided a dual-control Piper PA-18; Piper Aircraft loaned a PA-180A; Delta Air Lines, a 225-hp. dual-control Stearman; Gulf Coast Dusting Co., Houston, a 220-hp. Stearman. Five crash helmets and special goggles were loaned by General Textile Mills, Inc., N. Y.; two HF radio sets by Air Associates, Dallas; gas mask and respirators by Mine Safety Appliances Co., Pittsburgh, Pa.; an intercommunication set by Southmost Aviation, Brownsville, and earphones and throat mike by Texas Dusting Service, Rio Hondo, Tex.

The College System provides instructors, classrooms and typical fields for spraying and dusting runs.

The curricula include 30 flight hours, 12 laboratory hours and 78 class hours in each six-weeks course. Tuition fees run from $146 for the classroom subjects alone through $521 for classroom, laboratory and flight time. The college will supply meals, laundry and room services for the six weeks for $96. Students can defray costs with the aid of the Veterans Administration under Public Law 550 (Korean Bill). This will absorb about three-fourths of the costs of flight time and total charges

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for classroom and laboratory work.

Costs to the college for the initial course came to $3,589; after donations and tuitions there remained a balance of $748 available to be applied towards financing the next course.

Because of limited facilities available in the initial stages of developing the school, a special committee of applicators and Gale Hanson laid down these requirements for entrance:

- **CAA commercial pilots'** rating or higher.
- **Minimum of 500 hours** solo, with a substantial portion on airplanes of less than 500 hp., or sponsorship by a Texas Aerial Applicators Assn. firm.
- **Adeptness at handling** the type airplane on which training is given—if the first two lessons show that this is not the case, the student is dropped.

If the number of applicants exceeds the number that can be handled, the most eligible are chosen.

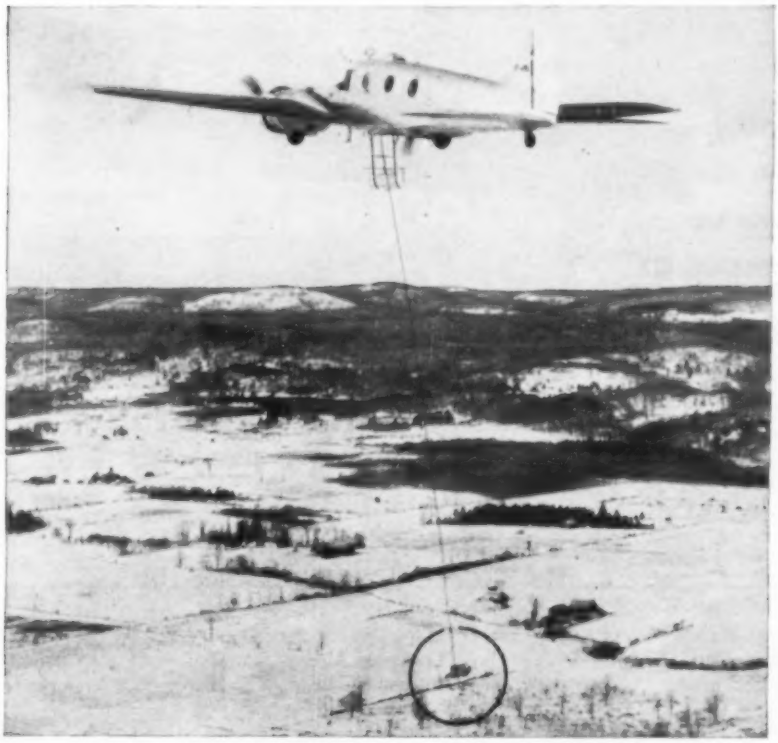
Currently, the facilities can handle eight students for the full 30 hours flight work. Additional students can enter if they desire only to take the ground courses.

The flight curricula was developed by Gale Hanson after an evaluation of the most common causes of aerial applicator accidents and fatalities. He determined that there has been little or no change in aircraft damage sustained-type accidents since 1951; an agricultural airplane is destroyed or receives substantial damage every 2,100 hours of crop control time flown. As regards fatalities, the following pattern has been consistent since 1950: a fatal or serious accident every 7,000-8,000 hours flown.

A general breakdown of these accidents shows that 32% result from stalls, 39% from hitting obstructions, 24% from reported mechanical failures and 5% from effects of chemicals on pilot. Hanson also noted that on surveying the 23 operational phases of aerial application, 86% of the accidents were occurring in only seven of the phases.

The breakdown: takeoff run, 8%; climb-out, 13%; flare-out for swath run, 14%; during swath runs, 12%; pull-up from swath runs, 16%; procedure turnarounds, 10%, and the landing phase, 13%.

On the basis of accident evaluation,



Airborne 'Eye' Finds Copper and Lead

New highly sensitive electromagnetic detector trailed by this Avro Anson picks up the presence of heavy sulphide deposits, such as copper and lead at depths of 300 ft. under good conditions. The Anson is the first of three planes to be fitted with the equipment and operated by newly formed Aerophysics of Canada, established by Spartan Air Services, Canadian Aero Service and McPhar Geophysics. Aerophysics will contract for airborne exploration of base metals, said to cost one-tenth of comparable ground surveys.

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Field of engineering

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Home Phone

Where employed

it was determined that basically each spray/dust airplane should be equipped with the following instrumentation:

- A fully functioning airspeed indicator.
- **A green light** set to flash on whenever the airplane is in its best-angle-of climb attitude.
- **A red stall-warning light** set to go on when the airplane is two miles-per-hour above its straight ahead power-off stall-speed. The red-and-green lights would function at the right time to warn the pilot of marginal flight conditions regardless of load, attitude, power on or off or angle of bank.

Hanson believes that with proper flying techniques, mandatory use of crash helmet and shoulder harness and the stall-warning equipment installed as recommended, some 50% of agricultural flying accidents could be eliminated.

Flight Technique

The flying technique used for the Texas A&M agricultural-pilots curricula is especially designed to minimize the probability of accidents during the seven most critical phases of operations:

- **Takeoff phase:** Students are trained, by means of the airspeed indicator, to find the aircraft $V_{min.}$ and $V_{max.}$ and the aircraft's best angle-of-climb speed. They are then urged to hold the plane on the ground until they have attained a couple of miles-per-hour above $V_{min.}$ Then they are told to lift off and ac-

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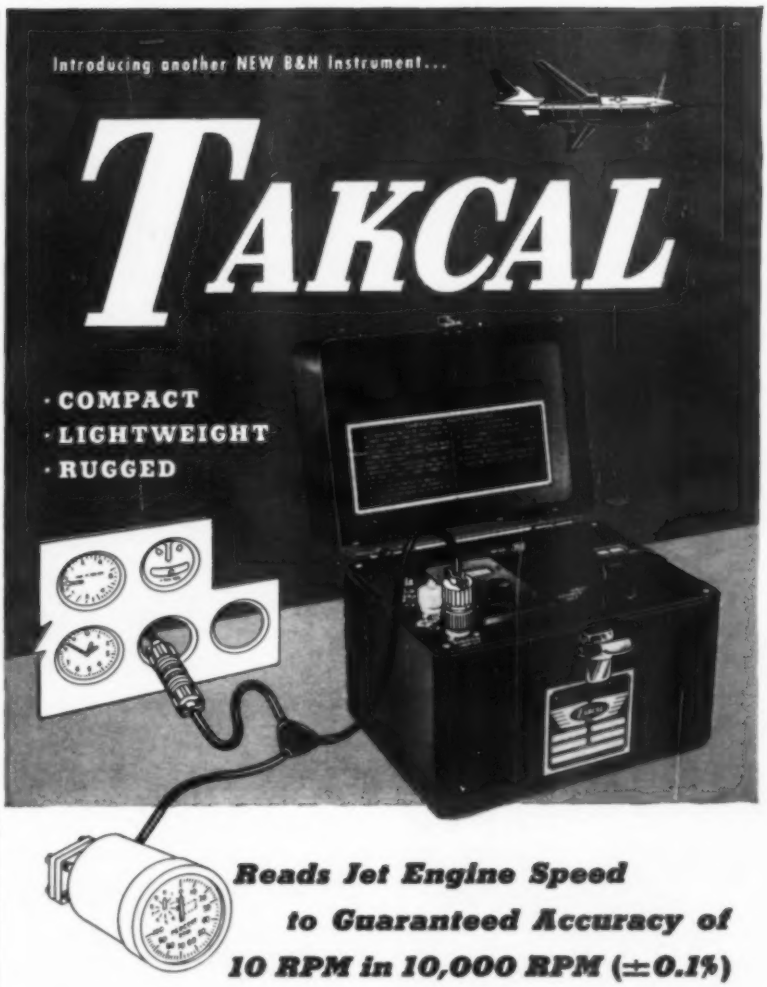

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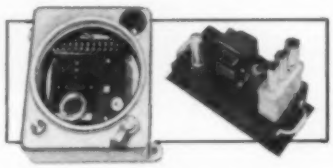

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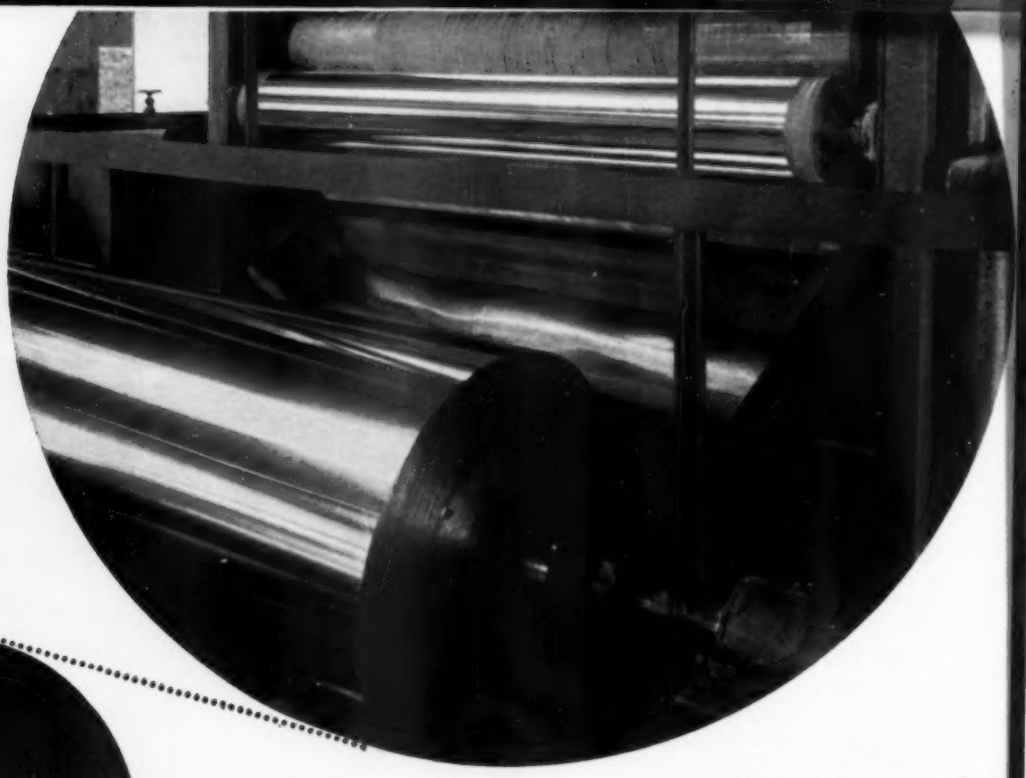

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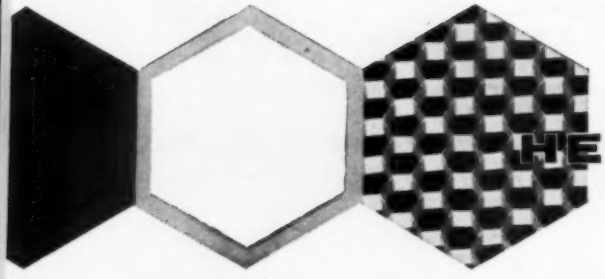

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celerate to best angle-of-climb speed before climbing, or to hold the airplane on the ground and get to best angle-of-climb-speed before taking off and climbing. Either way, the same run will be needed for takeoff, and airspeed is the best indicator in this case.

Pilots also are told to reduce this ground run to sea level and standard temperature conditions. Then it can be corrected for all temperatures and density altitudes, and the pilot always will know how much of a ground run is needed to accelerate to best angle-of-climb speed. In addition, a further requirement should be to have all takeoff strips at least three times the length of the needed ground run so that the pilot can stop if not airborne at the climb-out point.

• **Climb-out phase:** Most climb-out phase accidents are caused by getting the aircraft off the ground on the strength of ground effect and then not being able to climb, or from climbing too steep after takeoff. Ground effect is good vertically for about the wingspan of the airplane, Hanson points out, and will increase the rate of climb approximately 300 fpm. above normal. Generally, pilots will get off and continue flight at about the wingspan of their airplane, then continue at this height until they crash into obstructions at the end of the strip. It is impossible to go from $V_{min.}$ speed or less to $V_{max.}$ without losing altitude.

• **Flare-out for swath run:** Accidents often happen when pilots descend into a field in a nose-high, mushing attitude; a wingover turn, or start a steep descent at swath speed, leaving insufficient altitude for flare-out. The best-angle-of-climb indicator will monitor this condition; the light will come on at the best angle of attack regardless of load, attitude or bank. The descent point should be reached from a constant altitude turn at the best-angle-of-climb-speed. While descending the airplane will accelerate to swath speed and a rapid flare-out is possible without mushing into the ground.

• **Swath run accidents:** These generally happen because when the plane snags crops on its wheels and booms or flies in a nose-high, near-stall attitude. Pilots should be required to fly at the plane's normal cruise speed to maintain control; booms should be designed to provide penetration of chemicals into crops from a safe altitude.

• **Pull-up from swath runs:** Accidents often happen in this phase because the pilot waits too long before starting his pull-up, makes a steep pull-up from a nose-high, near-stall attitude and attempts near-vertical pull-ups.

The stall-warning light and best-angle-of-climb light will assist the pilot in taking the guesswork out of this

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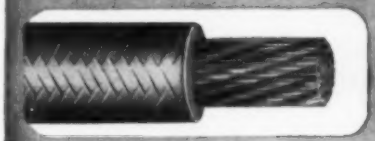

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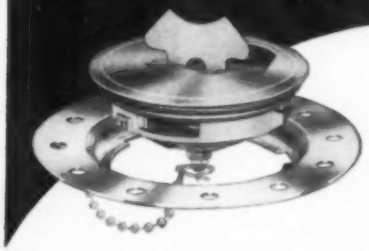

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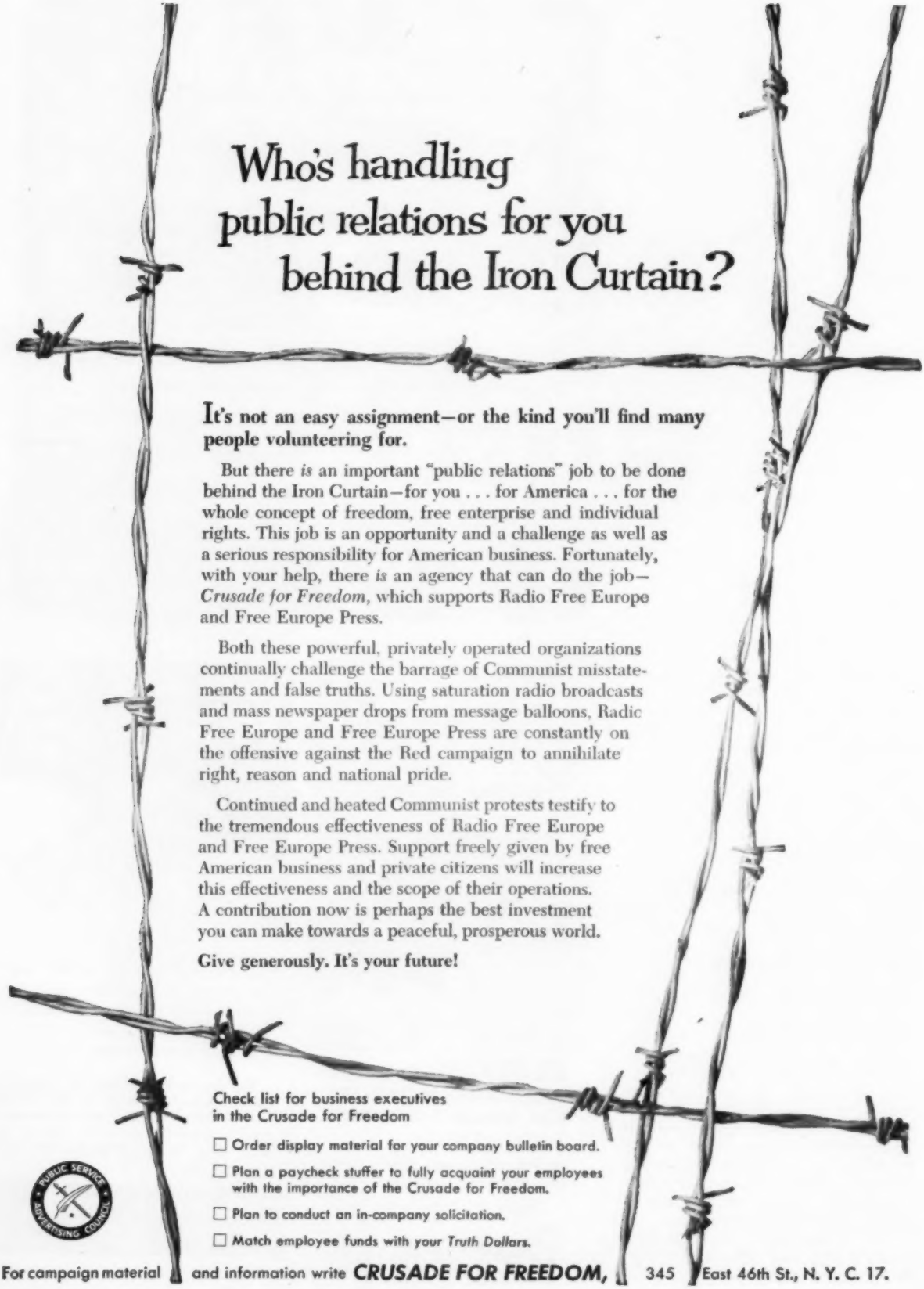

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procedure. During pullups, the plane's attitude should be changed to best angle-of-climb attitude; the plane's momentum will carry it to 100 ft. in best-angle-of-climb attitude before its speed slows to best-angle-of climb speed. If the pilot errs in this procedure, his stall-warner light will alert him in time.

• **Procedure turns:** Most procedure turnaround accidents start with poor pull-up techniques—from turns in which top rudder is used—from attempts to make bottom rudder skidding turns, from reversing downwind into-the-wind turns too fast, causing the plane to snap over the top.

Pilots are taught the dangers of applying too much power in a stall condition and how excessive top rudder will make the aircraft spin over the top in tight turns. They also are told that it not only takes longer to make a bottom-rudder skidding turn but that the aircraft can spin under without warning. Hanson emphasizes that the stall warning light will allow the tightest possible safe turn to be made without guesswork.

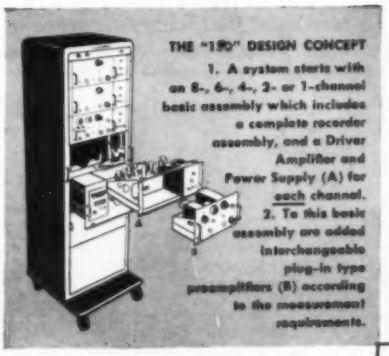
• **Landing phase:** The technique used at Texas A&M is to make slow power approaches using the stall warning light as the limiting factor. The plane is brought in tail low and slow enough so that when ground contact is made, the pilot can either push the stick forward, riding on the main landing gear for good visibility, or pull the stick back for a three-point landing.

PRIVATE LINES

Retractable fuel dump chute has been installed on a Lockheed Lodestar owned by Jones & Laughlin Steel Corp. Installation was made by Pacific Airmotive Corp.'s Aircraft Division, Lockheed Air Terminal, Burbank, Calif.

Parachute Flares as an Aid in Night Landings is title of Civil Aeronautics Administration Safety Release 403, containing salient extracts from Aeronautics Bulletin 17 published by University of Illinois Institute of Aviation, Urbana, Ill. (AW Jan. 23, p. 68).

Seventh annual Pacific Coast Intercollegiate Flying Meet, open to pilots and student pilots from all colleges in that area, will be held May 5th at Cable Airport, Claremont, Calif. Five events will be featured: 180-deg. power-on wheel landing; 180-deg. power-off spot landing. Maximum numbers of entries from any school: six licensed pilots and four student pilots. For entry forms write: M.S.A.C. Flying Club, Mount San Antonio College, Box 801, Pomona, Calif.



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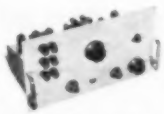

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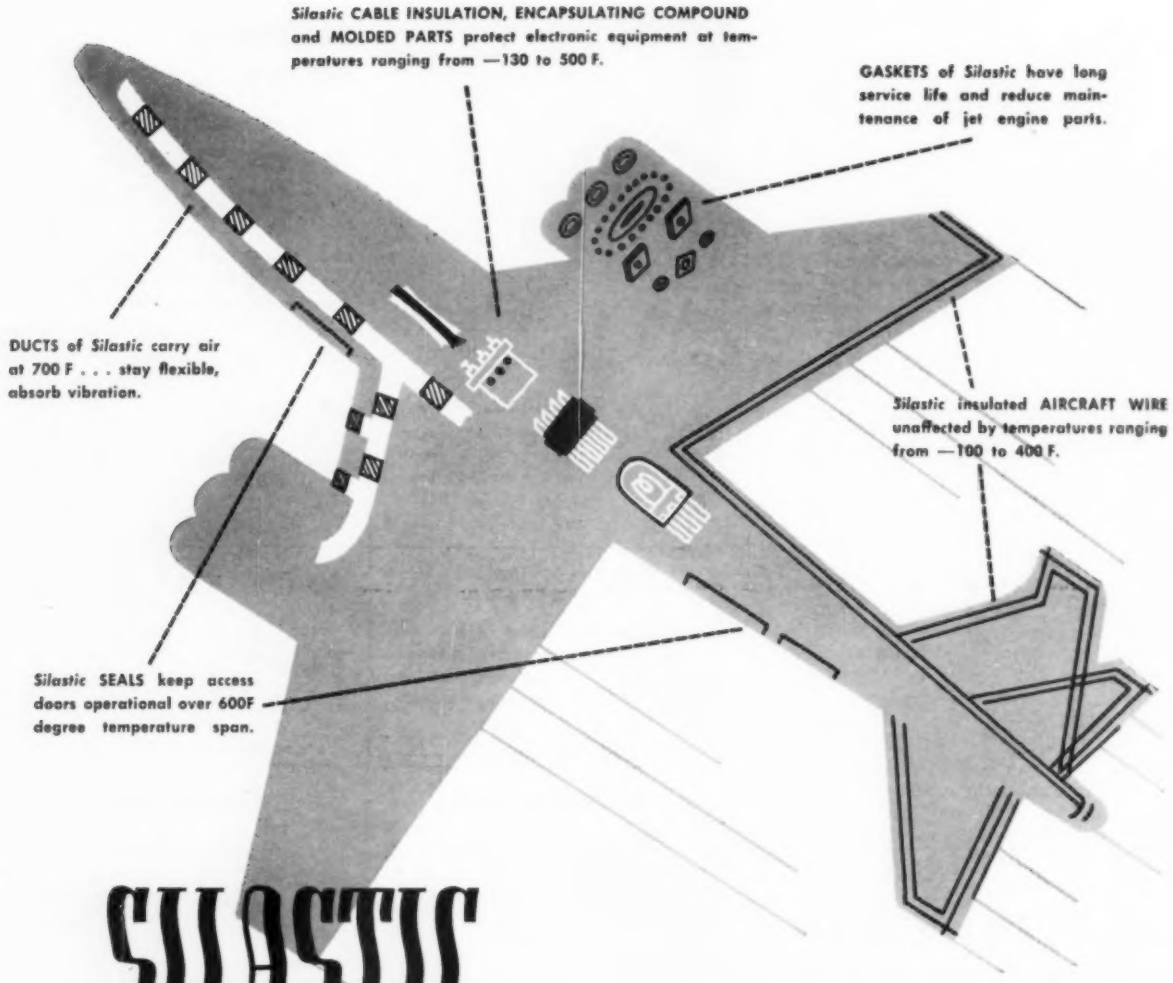
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British Report on Canadair Accident

Pilot Error Gets Blame for C.4 Crash

A Canadair C.4 Argonaut, G-ALHL, owned and operated by British Overseas Airways Corp., crashed during a night approach at Idris Airport, Tripolitania, Libya, Sept. 21, 1955, instantly killing 15 of the 47 occupants of the plane, including two of the crew and injuring 21 of the remainder.

The crew of seven consisted of Capt. R. D. E. Griffiths, First Officer J. I. Davies, Navigating Officer C. G. G. Havens, Radio Officer G. Berrisford, Steward C. J. Smart, Steward W. G. Gauldie and Stewardess M. E. Denys-Burton.

The accident took place at 22.23 hours Greenwich Mean Time (all times in this report are GMT).

The aircraft was operating the Rome-Tripoli sector of B.O.A.C. scheduled service BA/255.120 (London – Rome – Tripoli – Kano–Lagos). The accident occurred during the fourth attempt to land at night on runway 11 at Idris Airport in conditions of strong wind and poor visibility. During the last approach, the aircraft struck trees and crashed approximately 1,200 yards short of the runway. Fire broke out before the aircraft came to rest.

NOTIFICATION

The Director of Civil Aviation was notified by telephone from Air Traffic Control, Idris Airport, at about 22.30 hours the same day. The scene of the accident was visited within an hour.

Subsequently, the Minister of Communications ordered a Board to investigate the accident on behalf of the Government of the United Kingdom of Libya. The Investigating Board was constituted as follows:–

- **President:** The Director of Civil Aviation, United Kingdom of Libya.
- **Member:** The British Accredited Representative (a Senior Inspector of the Accidents Investigation Branch, Ministry of Transport and Civil Aviation, London).
- **Member:** A B.O.A.C.'s Representative (a member of B.O.A.C.'s Accidents Branch).

The first meeting of the Board took place on 23rd September, 1955.

FURTHER DETAILS

The aircraft had been constructed by Canadair Ltd., Canada, and delivered to B.O.A.C. in August, 1949, having been first registered in the name of B.O.A.C. on March 2nd, 1949. It was granted a Certificate of Airworthiness and this Certificate, No. A. 807, was valid until August 14th, 1956. At the time of the accident, it had flown a total of 15,517 hours.

Inspection of the records shows that the aircraft had been correctly maintained in accordance with the maintenance schedule approved by the Air Registration Board of the United Kingdom of Great Britain, and that all mandatory modifications had been carried out. The last maintenance inspection was a major check (Check 4) carried out at London Airport following which a Certificate of Maintenance was issued on September 20th, 1955. This Certificate would have remained in force for a period of 110 flying hours or 31 days and was therefore still valid at the time of the accident. During the flight from Rome to Tripoli no defect was experienced.

On departure from Rome on September 21st, 1955, the laden weight of the aircraft was 34,296 kgs. or 2,899 kgs. below the maximum permissible takeoff weight, the fuel load being 5,243 kgs. On arrival at Tripoli, the laden weight of the aircraft is calculated to have been 31,356 kgs. and it was, therefore, 1,294 kgs. below the maximum permissible weight for landing of 32,650 kgs. It has been estimated that at the time of the accident 1,953 kgs. of fuel, i.e. 613 Imp. gals., remained in the tanks. The Centre of Gravity was within the prescribed limits for the safe operation of the aircraft.

The Captain and First Officer have stated that throughout the flight and at the time of the accident there was no mal-functioning of any part of the aircraft, its controls, instruments, engines or equipment.

The aircraft was fitted with four Rolls-Royce Merlin 724-1c engines, the details of which are as follows:–

- No. 1. Serial No. 310899. Running time since overhaul 507 hours.
- No. 2. Serial No. 310919. Running time since overhaul 893 hours.
- No. 3. Serial No. 310761. Running time since overhaul 190 hours.
- No. 4. Serial No. 310837. Running time since overhaul 922 hours.

The maintenance records show that the engines had been correctly maintained in accordance with the maintenance schedule approved by the Air Registration Board of the United Kingdom of Great Britain. The total times run were all within the prescribed overhaul period of 1,250 hours. At the time of the accident the Certificate of Maintenance was valid in respect of the engines.

The aircraft was fitted with four Hamilton Standard type Hydromatic 43D-50-61 propellers. The maintenance records show that they had been maintained in accordance with the approved maintenance schedule and that the Certificate of Maintenance was valid in respect of them.

The Crew

- **Captain Griffiths,** an Australian, is aged 39 and learnt to fly in the Royal Australian Air Force in 1940. During the time he was in the R.A.A.F. he flew Sunderland, Mariner and Catalina flying boats, and on leaving the Service in 1946 had completed approximately 3,000 hours flying–most of which had been as pilot-in-command. He joined B.O.A.C. on July 15th, 1946 as a First Officer, and until June 1st, 1950 served in the Corporation's flying boats, and for about 9 months of that time was an Acting Captain.

Following the withdrawal of the flying boats, he reverted to First Officer and converted to Argonaut landplanes. From June 1st, 1950 until the time of the accident he has been continuously employed in the Argonaut fleet, having been promoted to Captain on March 26th, 1954. His total flying experience is now 9,417 hours, of which approximately 6,500 have been with B.O.A.C.

On Argonaut aircraft he has approximately 1,700 hours as pilot-in-command and 1,900 as First Officer. During the 30 days previous to the accident he had flown 82 hours. Before leaving London on September 20th, 1955 he had had 14 days leave. The day before he left London Airport for Rome, he carried out simulated instrument let-down practices for 2 hours at the B.O.A.C. Training Unit at Meadowbank, London.

He holds Airline Transport Pilot's License No. 26061 which is valid and endorsed in Group 1 for Argonaut aircraft, and contains a current Instrument Rating. He also holds General Flight Radiotelephony License No. 1966 which is valid. His last check flight as Captain of Argonaut aircraft was satisfactorily completed on April 5th, 1955. He had landed at Idris Airport on 12 previous occasions, all of which were at night.

- **First Officer Davies** is aged 35 and learnt to fly with the Fleet Air Arm in 1940. He served in the R.N.V.R. from 1940-1946 and completed approximately 2,000 hours in the Service before joining B.O.A.C. on November 21st, 1946. He has been employed continuously as a First Officer except for two periods–the first from September 21st, 1947 to May 26th, 1950 when he was an Acting Junior Captain with West African Airways, and the second from August 7th, 1951 to October 13th, 1952 when he was an Acting Junior Captain with Gulf Aviation (both these airlines are associated with B.O.A.C.).

He has now a total of 6,959 hours of which 3,676 were as pilot-in-command and 3,283 as co-pilot; of these 2,441 hours were as First Officer on Argonaut aircraft. His total flying during the last 30 days was 107 hours. He holds British Airline Transport Pilot's License No. 9529 which is valid with a current instrument rating. He also holds General Flight Radiotelephony License No. 2098 which is valid.

- **Navigating Officer Havens** is aged 40 and served in the Royal Air Force from 1940-1946. He joined the B.O.A.C. on January 24th, 1946 and was regraded Navigating Officer 'A' on June 1st, 1947. Since April 1st, 1953 he has served in the Argonaut Fleet. His total flying experience is 7,353 hours of which 1,596 have been in Argonaut aircraft. He holds British Flight Navigator's License No. 1369 which is valid.
- **Radio Officer Berrisford** is aged 34 and

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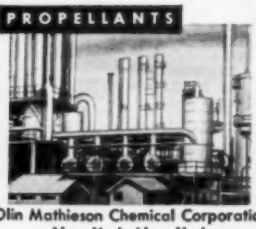

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served with the Royal Air Force from 1937-1947. He joined the B.O.A.C. on March 13th, 1947 and his total flying experience is 6,946 hours. He holds First Class Flight Radio Telegraphy Operator's License No. 1361 which is valid.

(Note: This was the first occasion on which this operating crew had flown together).

The Weather

The Meteorological Office, Idris Airport, issued, inter alia, the following weather reports to Air Traffic Control during the evening of September 21st, 1955:—

Time	Wind Speed & Direction	Cloud	Weather	QNH	Visibility
21.00	110° 17 kts. gusting 25	No low cloud	Rising sand	1014 mbs.	2 n.m. 4500 yds.
22.05	100° 20 kts. gusting 27	Nil	Rising sand	1012.8 mbs.	0.9 n.m.
22.24	120° 20 kts. gusting 28	Nil	Rising sand	1012.7 mbs.	2000 yds.

The 22.05 hours report was not transmitted to the aircraft. It was taken to the Air Traffic Control Tower by the Meteorological Observer at 22.09 hours. The Approach Controller on duty was at that time engaged in speaking to the aircraft. The Aerodrome Controller was out by the runway with a Very light pistol ready to assist the aircraft by firing signal cartridges. The Air Traffic Control Clerk was temporarily absent. The Meteorological Observer, therefore, left the report on the Aerodrome Controller's desk and it was not seen until after the accident. The 22.24 hours weather report was made at the request of Air Traffic Control immediately after the accident.

(**Note:**—The QNH is, briefly, the setting which if set on the sub-scale of the altimeter ensures that the instrument indicates height above mean sea level. Thus, with this setting, when the aircraft lands the altimeter should indicate the approximate height of the airport above mean sea level. The QFE is, briefly, the setting which if set on the sub-scale of the altimeter ensures that the instrument should read approximately zero when the aircraft lands.)

The Flight

The crew spent the night of 20th/21st September, 1955 in Rome. They left their hotel at 17.10 hours on September 21st, 1955 for Ciampino Airport. On arrival, the Captain visited the Meteorological Office and obtained a route and terminal forecast for the flight to Idris Airport. The terminal forecast gave the expected visibility at Idris Airport between 18.00 and 21.00 hours as 16 km. with the possibility of it decreasing to 6 km. in 'suspended sand'. The wind was given as likely to be 120° at 20 kts.

He also visited the Air Traffic Control Office at 18.25 hours and filed a flight plan giving an elapsed time for the flight to Idris Airport of 3 hours 4 minutes; his endurance was 6 hours, 6 minutes and his declared alternate aerodromes were Malta, Nice and Naples.

The aircraft took-off at 18.55 hours with an estimated time of arrival at Idris Airport of 21.59 hours. During the climb, icing conditions were encountered and at one stage power had to be increased to maintain the climb; but after passing through the cloud the ice gradually cleared and the flight proceeded normally to Palermo, whence Malta F.I.C. gave it a direct clearance to Idris Airport at 18,000 feet.

The weather for the remainder of the flight was "fine." During the whole of the flight and during the approaches to Idris Airport ultra-violet and dimmed red lighting were used to illuminate the aircraft instruments.

Clearance to Idris

Approximately 90 miles from Tripoli, at 21.37 hours, the aircraft began to communicate direct on VHF/RT with Idris Airport Approach Control on a frequency of 119.7 m/cs. It was given clearance for an unrestricted descent and flight to the airport, and was requested to report both when it was abeam Wheelus Field and when it had Idris Airport in sight. The aircraft crossed the Libyan coast at an altitude of 7,500 feet and when cleared to descend below 4,500 feet it received from Idris Airport the weather report for 21.00 hours.

The aircraft was also informed that two runways were available, either 11 or 18 whichever was desired. The Captain elected to land on runway 11 as he knew that there would be a strong cross-wind on 18. He also considered that his landing weight of approximately 71,000 lbs., together with the strong wind blowing down runway 11 would ensure that the length of that runway (1,600 yards) would be more than sufficient.

On a previous occasion in a strong wind he had landed on runway 11 without having to use propeller braking. He was fully aware that there were no lead-in or approach lights to runway 11 which was equipped with an electric flare path with four sodium lights at each end. Auxiliary gooseneck lighting had also been laid along it earlier that night.

The aircraft approached Idris Airport at 2,000 feet at approximately 22.00 hours. The airport lights could be seen from this height but not the actual runway lights. The aircraft commenced a left-hand circuit and flew to the south of the airfield. A descent was made to 1,200 feet QNH, and the flaps were lowered to 15°. Both the Captain and the First Officer had the 21.00 hours QNH set on their altimeters.

The aircraft flew towards the down-wind or western end of runway 11; as it came abeam of the runway at 1,200 feet the Captain could see the runway lights. He flew down-wind for 1 minute but before turning left on to base leg he lost sight of the lights. He turned on to base leg slowly descending in the turn to 650 feet QNH which height he then maintained with power settings of 48 inches of manifold pressure and 2650 rpm. As the aircraft came round on to a heading of 110° he saw the runway lights again but he was then 300 yards to the left of the runway.

It was impossible to attempt a landing and the Captain decided to overshoot and carry out another circuit (time 22.06 hours). During this first circuit considerable turbulence was experienced which made good instrument flying difficult and this was particularly so to the west of the airport.

The Captain went through the same circuit procedure again with similar results, except that on this second circuit the aircraft arrived slightly nearer the runway on

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its final approach. On this second and subsequent circuits the Captain was given VHF/DF radio bearings to help him line-up with the runway.

The Captain has said that after these two unsuccessful approaches he was not at all apprehensive about continuing to attempt to land on runway 11. He felt his only difficulty was in lining up with the runway in the poor visibility. He estimated that at the time of his second overshoot he could spend a further 30 minutes over Idris Airport without encroaching on the fuel reserve necessary to take him to his first alternate aerodrome—Malta.

After the second overshoot (time 22.10 hours) the Approach Controller told the Captain he would assist him to line-up by sending someone to the threshold of runway 11 with a Very light pistol to fire lights as the aircraft made its final approach.

Third Circuit Attempt

On the third circuit, the aircraft was better aligned with the runway but by the time the runway lights were sighted it was too high and too close in for the Captain to attempt a landing. He therefore took overshoot action again (time 22.18 hours) and flew low up the runway to assess for himself the visibility conditions for landing.

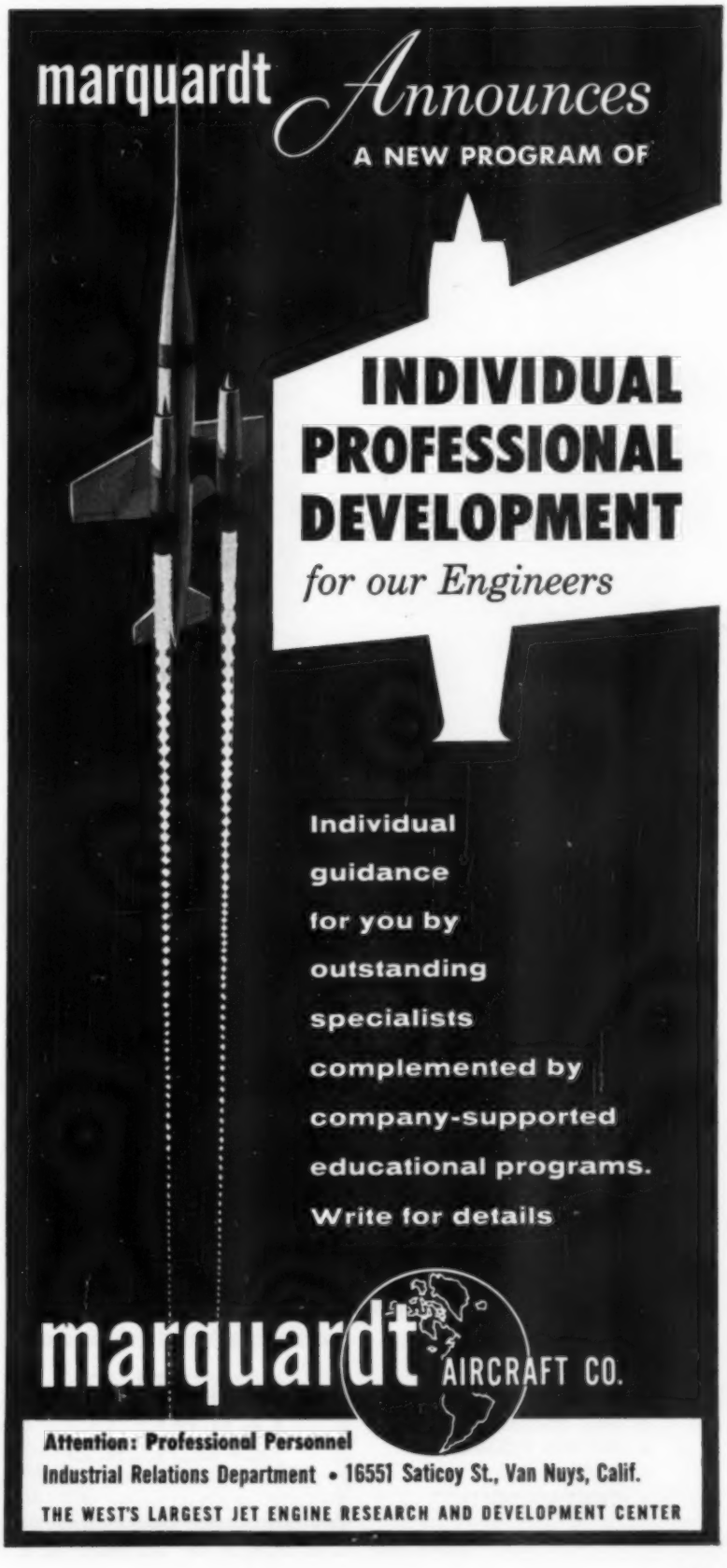
During the low level run up the runway, the First Officer reminded the Captain that they were flying with QNH settings on their altimeters (implying that their altimeters did not therefore indicate their height above the runway). The Captain replied to the effect that he was aware of this. He decided to carry out a low visibility runway approach procedure and climbed to 1,300 feet. The Captain instructed the First Officer to keep a close look-out for the runway lights during the procedure turns of the runway approach procedure.

The up-wind timed turn was completed at a height of about 1,300 feet QNH, and before the aircraft commenced its down-wind run the whole length of the runway lights could be seen. This indicated that the visibility was then at least 1,600 yards which was well above B.O.A.C.'s minimum visibility for landing.

Note: B.O.A.C.'s visibility minimum for landing at Idris Airport at night on all runways is 1,000 yards; the cross-wind component must not exceed 26 knots. This minimum and this maximum are contained in the Corporation's Operations Manual).

As the aircraft approached the down-wind threshold of runway 11 at 1,200 feet the Captain turned 45° to the right, turned back 10°-15° to correct for drift, and then continued on the new heading for 45 seconds before commencing a turn to the left. Again the aircraft encountered the more severe turbulence to the west of the airfield. During this turn the Captain reduced power and gradually descended to 650 feet QNH; after its completion, in order to maintain height at 125-130 knots, he increased power first to 52 inches manifold pressure and then reduced this to 48 inches. During the procedure turn the First Officer had completed the landing check which included lowering the undercarriage.

Shortly after the completion of the turn, the First Officer reported "runway ahead"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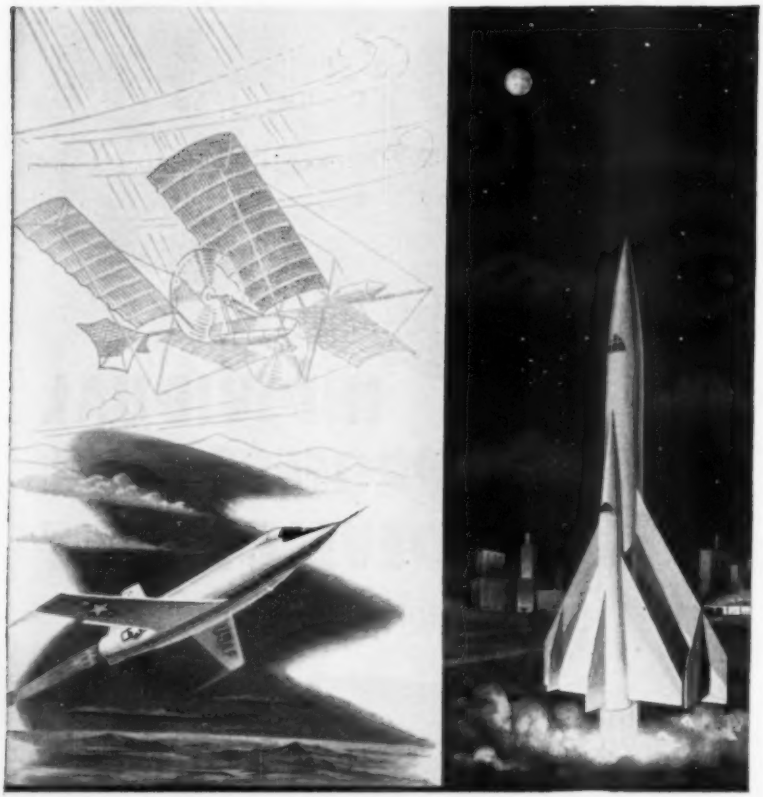

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SAFETY

and the Captain looked at his altimeter and saw that it was indicating 610 feet (i.e. about 350 feet above the level of the runway). Having a clear view of the lights he decided to make a visual approach and reduced power to 40 inches using this setting because of strong wind conditions and the necessity of making a flat approach.

He considered that he would have to do a slight turn to port to line-up with the runway and he estimated that it was about a mile ahead. Shortly after commencing the visual approach, he was about to call for the First Officer to switch on the landing lights when he partially lost sight of the runway lights and saw what he thought to be a cloud of billowing sand. Having lost his visual reference he reverted to instrument flying and perturbed by what he saw, reached for the throttles to climb.

At that moment the First Officer called "Look out! Climb," and simultaneously the aircraft shuddered and a series of impacts followed. The aircraft crashed through lines of trees, hit the ground, and came to rest on fire in an olive grove.

Fire and Rescue Services

The fire spread rapidly and the whole aircraft was ablaze within two minutes. The majority of the passengers who survived escaped through the starboard emergency exits, and the crew escaped through the crew door on the starboard side of the flight deck. Before leaving the aircraft, the Captain went into the forward passenger cabin and assisted passengers to escape.

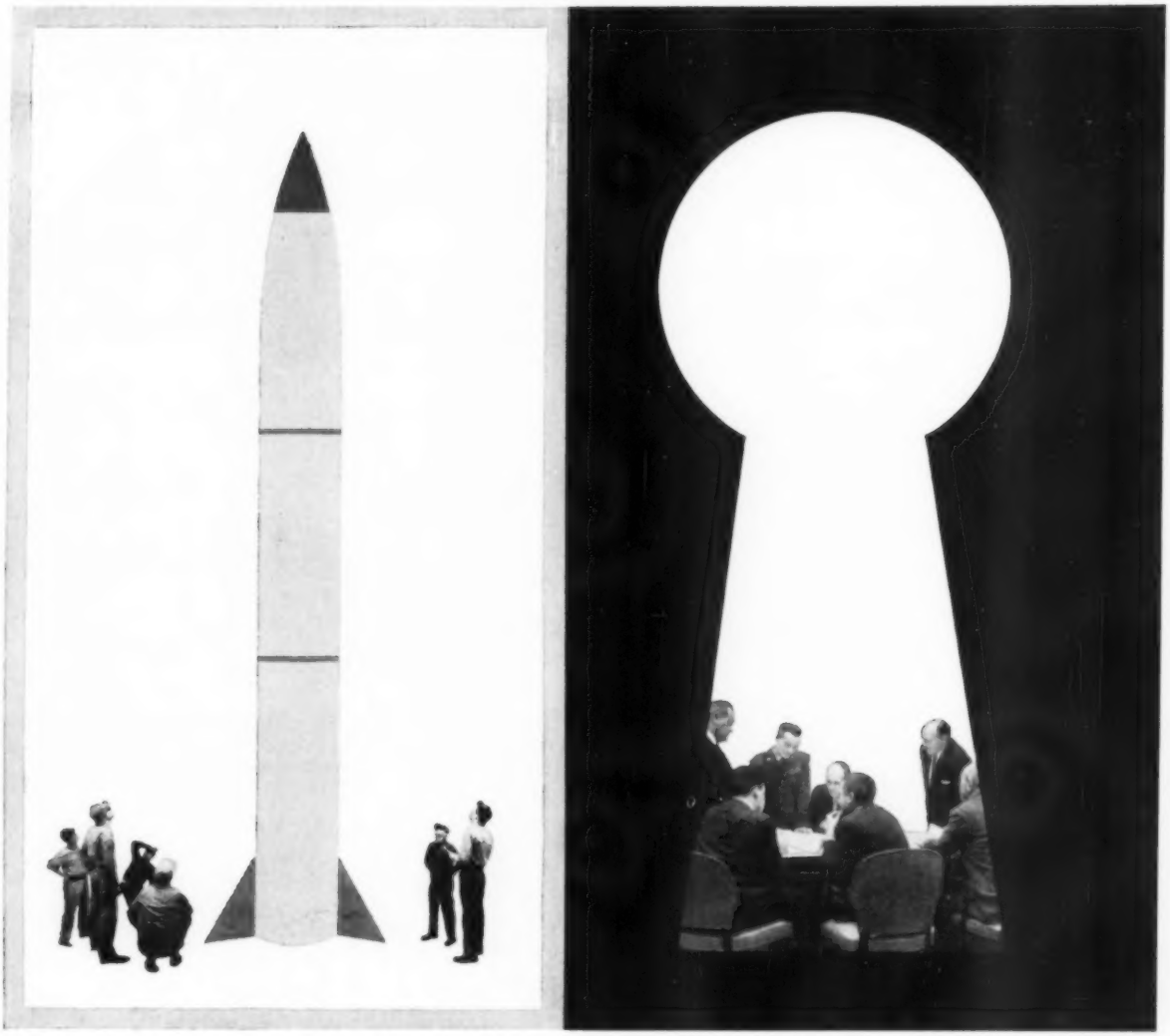
The first vehicles from Idris Airport Fire Service reached the scene of the accident in approximately seven minutes after the crash. They took a route made difficult by soft sand dunes through olive groves directly across country from where they had been stationed in readiness adjacent to runway 11. By the time they arrived much of the structure of the aircraft had been consumed by fire, and all survivors were out of the aircraft. The fire party therefore immediately concentrated on putting out the fire. Shortly afterwards, a large number of Royal Air Force personnel from the R.A.F. Station at Idris Airport arrived and together with the Airport Fire Service personnel rendered all possible assistance to the survivors some of whom were seriously injured. They also made a linked-arm search in the darkness and flying sand for possible missing survivors.

The survivors were taken in ambulances, buses and trucks to the R.A.F. sick quarters which were used as a casualty clearing station. The injured were afterwards taken to the British Military Hospital, Tripoli. Two U.S.A.F. helicopters arrived with medical supplies from Wheelus Field to render any assistance that might be required.

Examination of the Wreckage

Inspection at the scene of the accident showed that the aircraft had crashed on a soft, sandy cultivated area to the west of Idris Airport about 1,200 yards short of the threshold and 485 yards to the left of the extended centre line of runway 11. The ground at this point is 12 feet below the level of the threshold of runway 11.

The initial impact was with lines of eucalyptus trees bordering a narrow unmade



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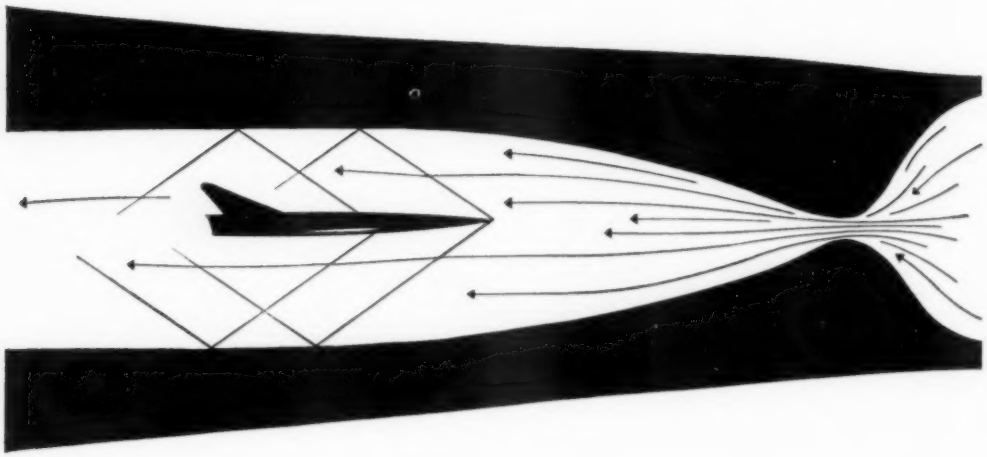

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road running east-west. These trees varied in height between 28 and 42 feet and had been cut off about 20 feet from the ground over a distance of 168 feet. The appearance of the gap so formed in the lines of trees suggested that the aircraft was approximately laterally level at the moment of impact.

Commencing 185 feet beyond the line of trees was a series of three ruts made by the landing gear of the aircraft. These ruts were on a heading of 130° and a line joining them with the point of impact with the trees indicated that the aircraft's angle of descent was about 4°.

About 400 feet beyond the initial impact with the trees, the aircraft crossed a second tree-lined sunken road running north-south. A gap 105 feet wide was torn in this second double line of trees; the trees at the left hand side of the gap were cut 25 feet from the ground, and the trees at the right hand side of the gap at 10 feet from the ground.

The right main and nose landing gear were torn out of the aircraft structure on first impact with the ground and this caused the right wing to drop and drag the ground resulting in the breaking away of the two right propellers. The right wing was torn away from the aircraft at about this point and its further disruption was the result of passing through the trees lining the second road. The aircraft, which had already commenced to yaw to the right, was slewed round still further as a result of the right wing dragging the ground and breaking away so that it passed sideways through the trees lining the second road with the left wing leading.

The fuselage and left wing finally came to rest about 550 feet beyond the first point of impact with the trees, the fuselage having slewed round 90° to the right.

Both left propellers had broken off at their reduction gear casings and lay between the second road and the main wreckage. The left wing had been torn off at the root, and lay parallel to the fuselage, and close to it. It was inverted and with the wingtip towards the tail. The left main landing gear lay burnt-out in the inner wing, having folded inwards.

Floor Displaced Upward

Both left engines had broken away from the wing; the outer engine having been driven inwards lay burnt-out in the remains of the wing leading edge. The inner engine had become detached from the wing and had also been driven inwards and lay burnt-out in the remains of the fuselage. When the aircraft was travelling sideways with the left wing leading, the wing broke away at the root and turned over. This led to the detachment of the propellers and the breaking away of the engines in an inward direction. The detached left wing, engines, and fuselage travelled forward together and as they came to rest, the left inner engine was driven up into the fuselage from below floor level.

The floor of the forward passenger cabin must have been considerably displaced upward and this resulted in the death or injury of the majority of the occupants.

Fire broke out before the aircraft had crossed the second road and the first evidence of burning was in the wreckage trail about 220 feet beyond the initial impact

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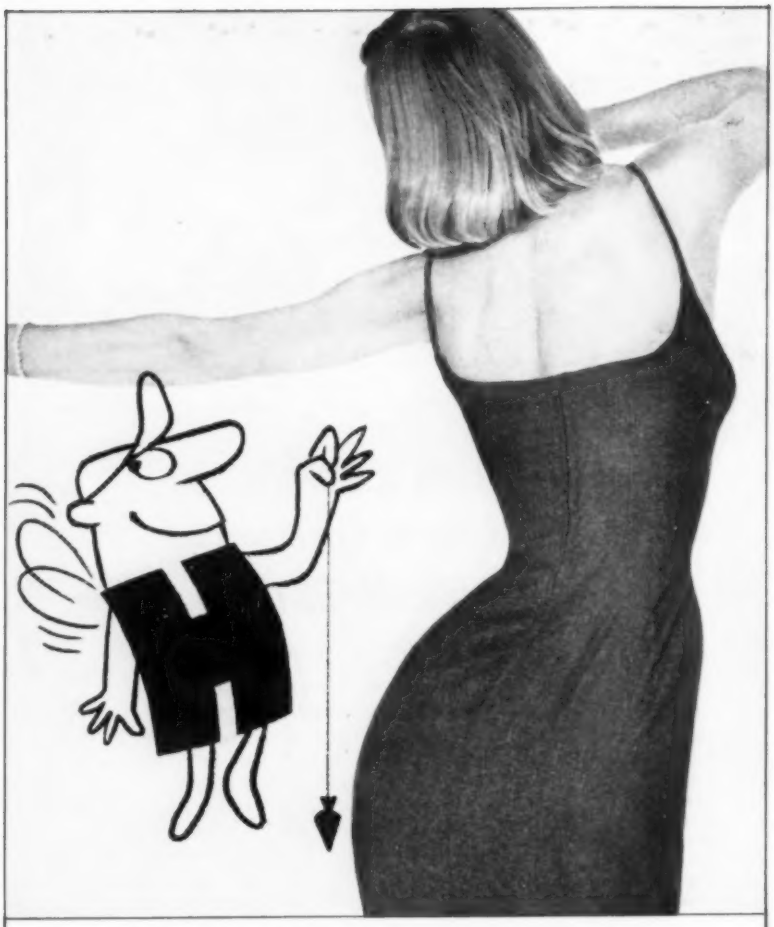

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with the trees. At the time of the crash the aircraft held about 600 gallons of fuel distributed between the main tanks.

On first impact with the trees, the integral tanks in the wings of the aircraft were torn open thus releasing quantities of fuel which became ignited before the aircraft came to rest. The detached left and right wings were severely burnt; the fuselage had been almost completely destroyed. The exceptionally severe fire damage was due to the fact that the fuselage came to rest close alongside and on the downwind side of the left wing which contained about 300 gallons of fuel. The rapid outbreak of fire within the fuselage was due to the fact that the left side of the fuselage had been torn open by the left inner engine thus providing entry to the fire already started at the left wing.

No Malfunctions

Examination of the wreckage showed that at the time of impact the landing gear was fully extended and the flaps partially extended. Due to impact damage it was not possible to determine the precise flap angle but it has been established that it could not have been less than 10°. The condition of the propellers indicated that the engines were developing power at impact, and examination of their pitch change mechanisms showed that they were all set at the fine pitch end of the normal constant speed range.

There was no evidence that any mechanical failure of the engines had occurred prior to impact. No evidence was found which would suggest any malfunctioning of the flying control circuits.

The remains of the Captain's altimeter were recovered and by comparison with a similar instrument it was established that the millibar scale was set at 1014. The remains of the First Officer's altimeter were recovered, but it had been so severely damaged by fire that its setting could not be established. The pitot/static system had been completely burned out and it was not possible to carry out any check of the system or to establish whether it was selected to normal or alternate source.

Emergency Exits

A total of six emergency exits are provided in an Argonaut, 3 on each side of the fuselage. There are four of these exits in the front passenger cabin and 2 in the rear. The mechanism of the centre emergency exit on the left hand side was found in the closed position. The remains of the other emergency exit were not identified.

No useful evidence was obtained from the remains of the passenger seats; they had been so badly burned that only the steel components remained. The floor of the passenger cabins had also been consumed so that it was impossible to assess the behaviour of the seat structures during the crash.

The remains of the crew door were found with its operating mechanism in the open position. The main passenger door had been completely destroyed by fire and the position of its operating mechanism could not therefore be determined.

The aircraft's automatic crash fire extinguishing system had operated but the

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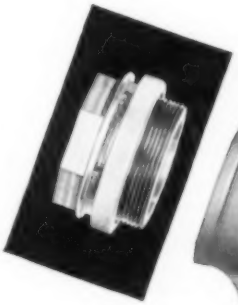

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discharge of extinguishing media had little effect on the outbreak of fire which was remote from the areas covered by the installation.

OBSERVATIONS

(i) **The Captain's decision** to use runway 11 was justifiable. A civil DC-6 aircraft landed without difficulty on this runway in similar conditions approximately 1 hour after the accident. Although the cross-wind components on the long runway 18 was less than the Corporation's permissible maximum it was sufficiently strong to warrant the rejection of that runway in favour of the shorter runway 11.

However, having failed on three occasions to line-up and land on runway 11, it is considered that the Captain should have revised his decision not to use runway 18 which had better approach aids namely, lead-in lights, a locator beacon, and the VHF/DF more favourably positioned.

(ii) **During the final procedure turn,** the Captain gradually reduced height from about 1,200 feet to 650 feet QNH. The undercarriage was lowered in the turn. On the completion of the turn the Captain increased power to check his descent and maintain height, and almost immediately afterwards the First Officer reported 'runway ahead'. The Captain noticed at that moment that his altimeter was indicating 610 feet. He immediately reduced power to commence a visual approach and descent. The conditions were turbulent which made accurate flying difficult. Within a short space of time—a few seconds—the Captain saw the billowing sand ahead and the aircraft struck the trees before he could climb.

The height of the ground where the aircraft struck the trees is 243 feet above mean sea level which is 12 feet below the level of the threshold of runway 11. This indicates that the aircraft lost approximately 350 feet in a short space of time.

It would appear therefore that the aircraft's descent was never fully checked after the completion of the procedure turn, and that the rate of descent increased after the Captain reduced power to make his visual approach. It is significant that after noting the 610 feet and after commencing his visual approach the Captain apparently did not refer again to his altimeter.

It is apparent that he did not realize that his approach path had become too steep and the aircraft was becoming dangerously low.

(iii) **The use of a QNH altimeter setting** means that in order to obtain the true height above the aerodrome a pilot must subtract the known altitude of the aerodrome from the altitude indicated by his altimeter. When a QFE setting is used the height above the aerodrome is read directly off the instrument. A pilot must therefore be quite clear in his mind whether he has a QNH or QFE setting.

The Board has considered the possibility that the Captain having a QNH setting on his altimeter treated it on the final approach as a QFE setting; and, indeed, this would appear to be the most logical explanation of the accident.

The Captain stated that he has on oc-

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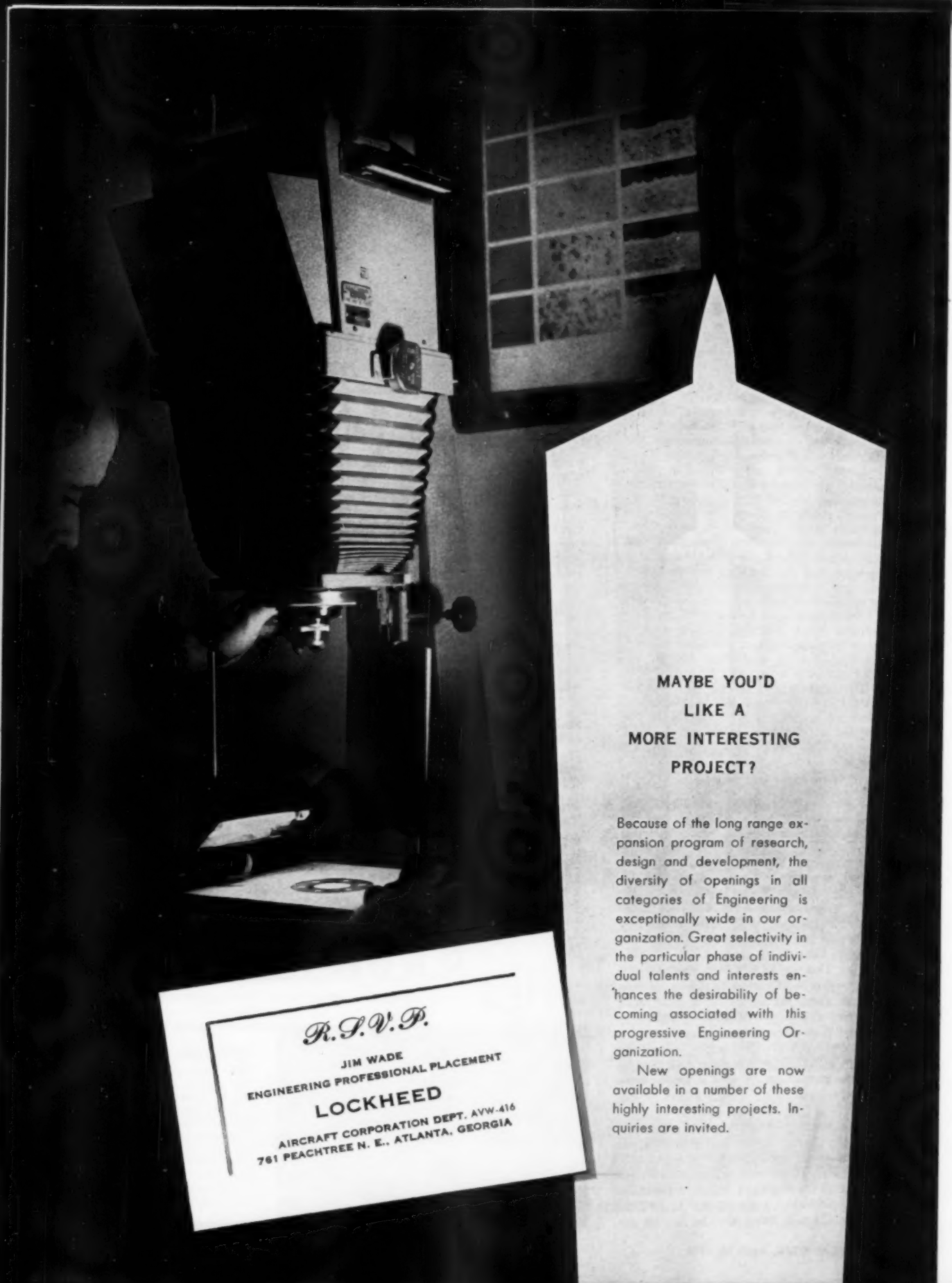

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casions used a QFE setting for landings. However, on the overshoot after the third attempt to land, the First Officer reminded the Captain that he was flying with a QNH setting on his altimeter and the Captain confirmed that he was aware of this. The Captain therefore appeared to be fully aware of the type of setting he had on his altimeter, and in the absence of further evidence to the contrary the Board must accept that he made his final approach with no confusion in his mind as to the type of altimeter setting he was using.

(iv) **The Board is aware** of the circumstances which led to the non-transmission of the 22.05 hours weather report which included a reduction of 1.2 mbs. in the QNH. Had the Captain received the amended QNH and made the adjustment to his altimeter, it is assumed that he would have carried out his instrument procedures approximately 30 feet higher, but it is considered that this adjustment would have had little effect on his visual final approach.

Consequently, whilst the omission to transmit this report cannot be condoned, the Board considers that an adjustment of 1 mb. during his attempts to land would not have materially affected the course of events. The aircraft crashed 1,200 yards short of the runway on ground that is 12 feet below the level of the runway threshold whilst it was descending at a relatively steep angle. At this distance from the runway, assuming a 2½° glide path and a touch-down point 100 yards up the runway, the aircraft should have been at least 170 feet above the ground.

(v) **The trees struck by the aircraft** in no way constituted an obstruction to the runway (as defined in I.C.A.O. Annex 14, part 5, Chapter 1, para. 1).

CONCLUSIONS

(i) The aircraft was properly certificated and documented, and had been maintained in accordance with the approved maintenance schedule.

(ii) On departure from Rome it was correctly loaded with its Centre of Gravity within the prescribed limits, and on arrival at Idris Airport its weight was below the maximum authorised for landing.

(iii) The captain and crew were experienced and properly licenced. They were not fatigued at the time of the accident and were in good health.

(iv) The visibility at the time of the accident was above B.O.A.C.'s operating minimum for the use of both runway 11 and 18. The cross-wind component on runway 18 was below B.O.A.C.'s maximum.

(v) The 22.05 hours weather report which showed, inter alia, a decrease of 12 mbs. in the QNH setting was not passed to the aircraft.

(vi) The 21.00 hours QNH of 1014 mbs. was set on both pilot's altimeters. The Captain was aware that he was flying on a QNH setting.

(vii) The Captain's selection of runway 11 in preference to runway 18 was justifiable, but after having failed on three occasions to line-up and land on that runway he should have revised his decision not to use runway 18.

(viii) The First Officer carried out his duties satisfactorily. He had been instructed

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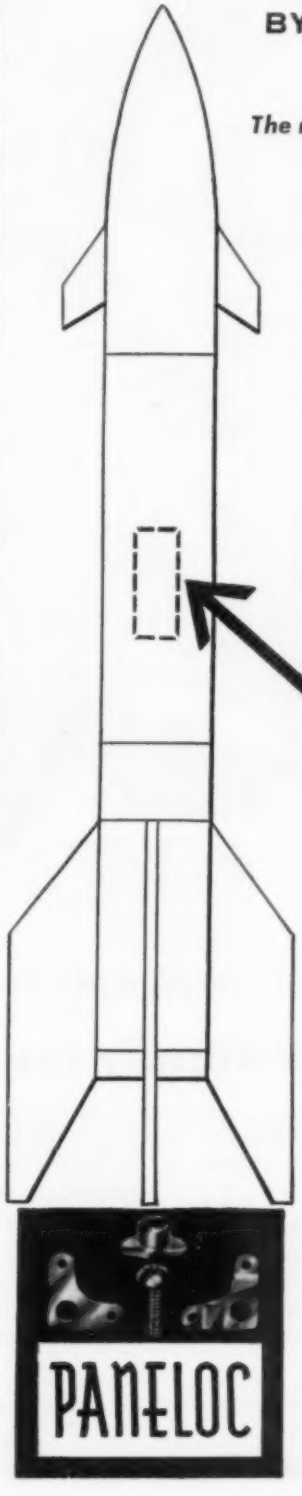

The next 135 words of this advertisement taken from Bell Engineers' letters

S. W. Esmond, Product Engineer:

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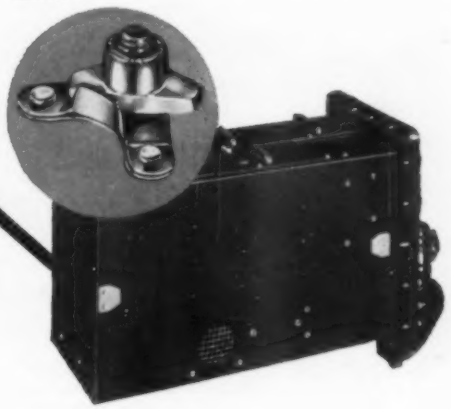

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by the Captain to keep a close look-out for the runway lights and afterwards he was so fully occupied with his prescribed duties that he was unable to monitor the flying instruments on the final approach.

(ix) On his fourth attempt to land the Captain was carrying out a low visibility runway approach procedure.

(x) After the First Officer had reported "runway ahead" and the Captain had noted that his altimeter was indicating 610 feet he reduced power and commenced a visual approach.

In the restricted visibility the runway lights gave the Captain insufficient guidance as to his attitude, height and angle of approach and, consequently, he was not aware that the aircraft was descending below its correct approach path. The aircraft lost height too rapidly and struck trees 1,200 yards short of the runway threshold.

(xi) The turbulent air conditions on the approach to runway 11 made accurate flying difficult and together with the strong wind may have contributed to the aircraft's rapid loss of height.

(xii) With the exception of the omission to send the 22.05 hours weather report, Idris Airport rendered the aircraft all possible assistance.

(xiii) Idris Airport Fire and Rescue Services operated satisfactorily.

(xiv) There was no defect in the aircraft, its engines, instruments or equipment.

OPINION

The accident was the result of an error of judgment on the part of the Captain who having made three unsuccessful attempts to line-up and land on runway 11 on his fourth attempt allowed his desire to keep the runway lights in view to affect his judgment, in that during a visual approach to the runway he failed to make adequate reference to his flight instruments. In the restricted visibility the runway lights gave him insufficient guidance as to attitude, height and angle of approach and unkowingly he permitted the aircraft to descend below its correct approach path.

(Signed)

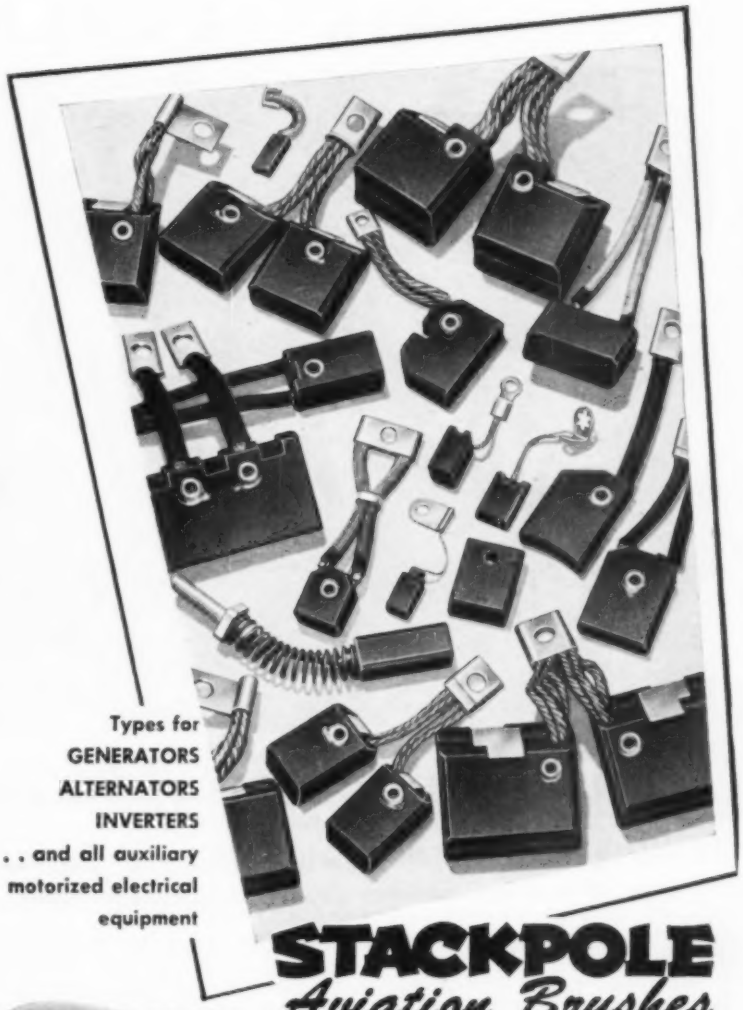
R. A. Webb, President (Director of Civil Aviation, Ministry of Communications, United Kingdom of Libya).

R. P. Garmons Williams, Member (Senior Inspector of Accidents, Ministry of Transport and Civil Aviation, United Kingdom of Great Britain).

B. J. Folliard, Member (Deputy Inspector of Accidents, British Overseas Airways Corp).

Air Loads Measured On Tunnel Models

Two precision air load measuring devices, costing almost $300,000, have been ordered from Westinghouse Electric Corp. by the Air Force. The equipment will be used in the gas dynamics facility and propulsion wind tunnel at the Air Research and Development Command's Arnold Engineering Development Center, Tullahoma, Tenn., to measure forces on test models of aircraft and missiles.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Transatlantic Travel to Reach New Peak

A record 400,000 scheduled-flight passengers predicted for summer as airlines step up schedules.

By Glenn Garrison

New York—Almost 400,000 transatlantic travelers will fly on scheduled flights between North America and Europe this summer.

This is the consensus of transatlantic airline officials surveyed by AVIATION WEEK.

These officials predict a summer traffic increase of 20% or more over that of record-breaking 1955.

Bearing them out, the airlines report that advance bookings already are 20% above those recorded for the same period last year.

At the end of March, typical reports showed that bookings were on a par with those for May, 1955—one airline had booked every tourist seat from May 15 through July 15, with heavy advance sales pouring in for the last two weeks of the month.

1955 Records

Last summer's scheduled passenger traffic over the North Atlantic totaled 328,706 passengers for the peak months from June through September, according to preliminary International Air Transport Association reports—an increase in itself of almost 20% over the same months of 1954.

For the entire year of 1955, the total was 652,000 passengers on scheduled flights plus another 40,000 passengers in charter flights.

Last year, seats available on the scheduled flights topped the one-million mark for the first time. The total was 1,006,000.

Anticipating even bigger and better records this year, the carriers are beginning the summer travel season with stepped-up plans to woo the travelers and to provide them with more seats, services and flights than ever before.

Tourist-Flight Emphasis

Even greater emphasis will be placed on the low-fare tourist trade.

Transatlantic tourist service began on May 1, 1952. Total scheduled traffic (first class and tourist) was 432,272 for that year (200,000 less than last year), IATA records show. Tourist traffic has accounted for almost all of the subsequent increase—of last year's 652,000 passengers, 462,000 flew tourist.

To attract additional vacationers, the airlines and travel agents this year are offering an increased quantity and variety of tours by air, ranging from a trip for golfers around the championship courses of Britain and France (via Trans World Airlines) to a skin diving expedition in the Rea Sea (Swissair).

Art-Lovers' Tour

Other examples of new tours are a combined sea-and-air European jaunt by British Overseas Airways Corp. and an art-lovers' tour by Scandinavian Airlines System.

To win travelers by influencing travel agents, Swissair is giving away hand-carved models of Swiss chalets to agents who do the best job at completing (in 25 words or less), the sentence, "I recommend Swissair to my clients because—"

The travel agent, in fact, brings in an estimated 80 to 85% of the airlines' total pleasure-travel business over the Atlantic, and all of the carriers direct considerable promotional effort to and through him. (The agent's cut of an overseas tour fare is 10%; if no "package" is involved, he gets 7½% of the transportation price).

New cities will be served both in the U. S. and Europe by the transatlantic carriers this year, and the networks of connecting services will expand.

To soothe the tourists possible financial qualms, the airlines will continue to offer pay-later services, which most agree

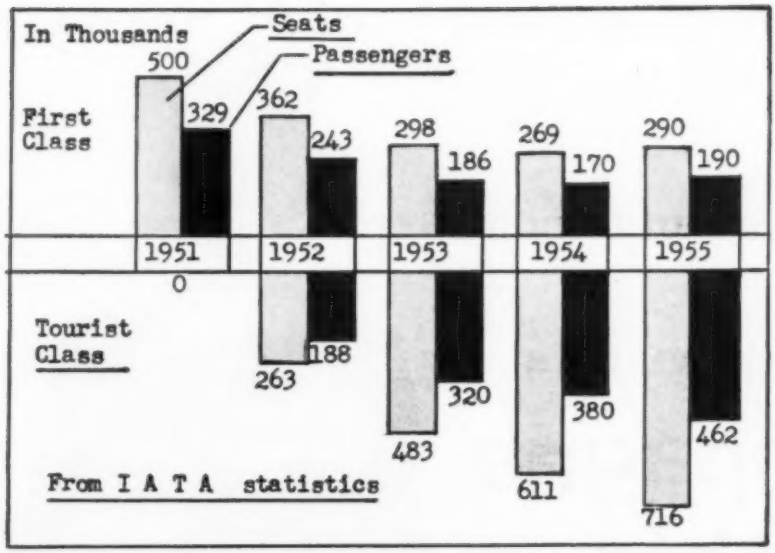

CHART shows steady rise in tourist passengers, erratic decline in first-class fares.

are a significant traffic stimulus. Pan American, for one, reports increased promotion of its pay-later plan and claims 17,000 credit customers since May, 1954.

To handle the expected flood of summer business, the airlines also are offering more seats and more weekly flights between the U. S. and Europe.

Pan American plans to provide a total of 50,000 seats each way during June, July and August, 20% more than last year. Tourist seats will account for 75% of this total—an increase of 35%.

Pan American is stepping up its flights to 75 weekly each way over the North Atlantic.

Disneyland and Tourism

Of the 3,000 seats weekly in each direction that TWA plans to offer during the peak season, 88% will be in the tourist bracket. Last summer, 83% of TWA's passengers flew tourist. The airline will schedule 50 flights to Europe weekly, among them a new single-plane service to Europe from Los Angeles and San Francisco via New York. (In exploiting this service at the other end, TWA is promoting Disneyland as an attraction for the visiting European).

British Overseas Airways Corp. is increasing its transatlantic seats about 10% with nine first class and two tourist flights weekly out of New York, two weekly tourist flights to Chicago via Boston and Detroit and seven other flights from Canada to Europe.

Air France, with an approximately equal ratio between first class and tourist, will increase its transatlantic flights to 20 a week from New York for the season and expects a 20% traffic increase over last year.

The Scandinavian Airlines System is adding two flights (one tourist, one first class) to its North Atlantic schedule for a total of 14 tourist and seven first class weekly with totals of 1,940 and 464 seats respectively. On its transpolar route between the West Coast and Europe, SAS will increase last year's first class flights to four first class and three tourist flights. Transpolar seats each way this summer will total 300 tourist and 256 first class each week.

Flights to Warsaw

KLM Royal Dutch Airlines will offer 21 weekly flights from New York, with some 50 conducted tours among its travel attractions. Service to 115 cities in 72 countries will be offered this year, KLM says, as compared with last year's 106 cities and 68 countries. New services include direct flights between New York and Warsaw.

Lufthansa will enter the summer season in its first full year of operation with a schedule of 11 weekly flights from the U.S., two of them out of Chicago. All of the West German airline's flights will be mixed tourist and first class.

Most of the other foreign-flag airlines in the United States-Europe service are stepping up their schedules and anticipating their heaviest tourist season. Among them, El Al Israel, Iberia, LAI, Loftleider, Sabena and Swissair will provide 36 transatlantic flights weekly each way during the rush.

TCA Plans

From Canada, Trans Canada Airlines will schedule 10 flights a week to Europe during the summer, three from Toronto and seven from Montreal. TCA's seats to Europe for the June-July-August peak will total 2,241 first class and 13,446 tourist—a rise of 11% and 35% respectively over last summer's totals.

Even higher volumes of transatlantic passengers in the years to come were forecast by John Brancker, traffic director of IATA, in a recent address at the European Travel Promotion Conference in New York.

Brancker told airline, travel agency, steamship and railroad officials at the conference that air capacity over the North Atlantic will be "very much more than doubled" within the next five years, while transit time will be halved and fares reduced.

By 1960, Brancker said, at least 1.5-million Americans should be visiting Europe each year.

Peak Traffic Figures

Totals of scheduled transatlantic passenger traffic for the peak months June through September during the last five years, as compiled from International Air Transport Association records:

Year	Passengers
1951	141,873
1952	207,670
1953	241,079
1954	271,583
1955 (EST.)	328,706

London-San Francisco Route Given to BOAC

Washington—A new intercontinental route from San Francisco to London has been approved by the White House and the Civil Aeronautics Board, for British Overseas Airways Corp.

The British airline also gained Detroit as an added co-terminal in the United States and is permitted to operate turnaround service between New York and Nassau, Bahama Islands.

The amendment of the BOAC foreign air carrier permit authorizes service already negotiated for a British carrier in the bilateral air agreement between the U.S. and the United Kingdom.

In the new BOAC permit, San Francisco is designated a co-terminal with New York on a new direct route to London.

Detroit is added to Chicago and New York as co-terminal on BOAC's main North Atlantic route.

The new New York-Nassau authority allows BOAC to operate turnaround service between the points instead of serving them only on through flights as it has in the past. Jamaica still can be served only on through flights to or from Europe, and BOAC is prohibited from serving Chicago, Detroit or Boston on flights serving the Bahama Islands or Jamaica.

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WESTERN AIRLINES

Growing Delta Faces Still More Growth

By Craig Lewis

Atlanta—Delta Air Lines, busy digesting one batch of new routes awarded five months ago, now has the prospect of another major expansion of its system before 1957.

By the end of April, Delta will have inaugurated a full pattern of service on new routes to the Northeast which the Civil Aeronautics Board gave it in the Southwest-Northeast Service Case.

Early this month, a CAB examiner advised the Board that Delta should be the carrier to compete with Eastern Air Lines and National Airlines on the rich New York-Miami routes. Some airline observers feel that if Delta gets the N. Y.-Florida route, it will gain stature and turn the Big Four into the Big Five by the early 1960s.

Recent Expansions

Extension into the Northeast has been important to Delta, since it provides access to the major population centers there. The N. Y.-Florida route would do the same.

Access to the new markets provides needed long-haul business for Delta—although a carrier operating between Chicago and Detroit in the North, Atlanta, Miami and New Orleans in the South and overseas to Caracas is hardly a short-haul operation.

Delta has inaugurated service on the routes to New York in three stages between Feb. 1 and Apr. 29. The initial schedule was a first class and two coach flights daily to major points—New York, Washington, Atlanta, New Orleans, Dallas, Ft. Worth.

On April 1, Philadelphia, Baltimore and Charlotte were added to the system with three daily Convair 340 flights. Houston and New York will be connected on April 29 with a first class flight via Atlanta and a coach service via Washington, Atlanta and New Orleans.

Surprisingly Good Start

When the CAB awarded the new routes, it estimated that Delta could make about $11 million a year from them. Delta figures that by April 29 it will have enough capacity on the routes to earn that amount with a 60% load factor.

The first two months' record shows that the new first class services to New York got off to a surprisingly good start—exceeding pre-inaugural estimates. Load factor increased from about 65% in February to nearly 80% in March. Although coach service hasn't developed as fast, Delta is satisfied with its record.

Coach load factor was up from the low 50s in February to more than 70% last month.

Delta feels that its intensive selling job on the new service is beginning to pay with increased identification in its new markets. It believes that identification is helped by such service features as cooking steaks to order. First class passengers on Golden Crown flights are asked how they like their steaks when they buy their tickets, and the preference becomes part of their reservation.

When service began on the new routes, Delta—like Braniff Airways—discovered it had to serve New York through Newark Airport because of congestion at the two New York terminals. Delta says it has ideal facilities at Newark, and it feels that using Newark has only minor disadvantages.

Newark is as close as LaGuardia Airport and closer than Idlewild to downtown Manhattan in ground time, and Delta feels it can offer a comparable service to most passengers. The carrier also believes there is a big air market in the industrial area around Newark that is being neglected.

Delta pays the cost of a New York Airways helicopter transfer to another New York Airport for connecting first class international passengers or first class domestic passengers traveling beyond New York if they have come from Atlanta or beyond.

Equipment Problems

Like many other airlines beginning new services awarded in last fall's rash of route expansion, Delta has equipment problems. These will be relieved somewhat this summer with the delivery of five Convair Metropolitans.

Summer delivery also is expected for four Lockheed Constellations which Delta recently bought from Pan American World Airways. Delta expects to utilize the Constellations for coach service.

The next delivery of new four-engine aircraft will come about a year from now when the carrier starts to receive its order of 10 DC-7s. Right now, Delta has 11 DC-7s, seven DC-6s, 20 Convair 340s, 14 DC-3s and two cargo DC-3s.

The company has ordered six DC-8s and reportedly is interested in the proposed Convair Skylark medium-range turbojet transport.

Delta's present route structure, which covers most of the eastern United States, is a far cry from the single-route airline President C. E. Woolman evolved from a Louisiana crop-dusting operation.

Delta has grown from its first domestic passenger route between Dallas and Jackson, Miss., in 1929 to a 10,765 mile system. In 1941, the carrier capped 12 years of operation in the South by moving its headquarters to Atlanta and making its first penetration of the North with a Cincinnati-Atlanta route. The airline expanded to the North and South in 1945 with new routes to Chicago and Miami.

Delta got into the international air market and greatly expanded its domestic system in 1953 by merging its routes with Chicago and Southern Air Lines' 5,854 mile system.

By last July, Delta reported that revenues for the year ending June 30, 1955, were $59,187,961—up from $50,333,882 in the 1954 fiscal year, the first full year of merged operations. Profit after taxes in Fiscal 1955 was $2,166,025.

In the last six months of 1955, Delta reported net income after taxes of $1,244,463, compared with $440,848 for the same period of 1954. Total revenues for the last half of 1955 were $30,126,473, up from $26,987,675 for the 1954 period.

Delta carried 1,049,916 passengers in the last six months of 1955 and 2,144,316 passengers in the whole year. Load factor for the six month period was 60.28%.

Mail Rates Reopened For 33 Lines by CAB

Washington—The Civil Aeronautics Board has reopened the mail rates of 33 subsidized airlines in an effort to set a formula for treatment of profits from equipment sales.

The rates were reopened Apr. 6 with the issues limited to the capital gains problem unless an airline should want to challenge another aspect of its rate. If a challenge is filed, the airline's entire rate level becomes open.

The CAB action deals with a problem that will become more intense as the airlines begin to re-equip for the jet age and start to dispose of their present fleets. The CAB offsets gains from equipment sales against subsidy needs, but the carriers feel they should have the money to re-invest in the expensive new aircraft they are buying.

The mail rate case is designed to develop a record on which the Board can form a policy for future treatment of equipment sales when it is setting mail pay for subsidized carriers.

Senate hearings began last week on legislation which would permit application of capital gains from equipment retirement against purchase of new aircraft and would eliminate the offset of such profits against subsidy need.

A. N. TUPOLEV (r.) Tu-104 designer and assistant A. A. Arkhangelsky.

COCKPIT DETAIL of Tu-104 resembles that of B-29 (note navigator

Tu-104 Interior: Damask for Jet Age

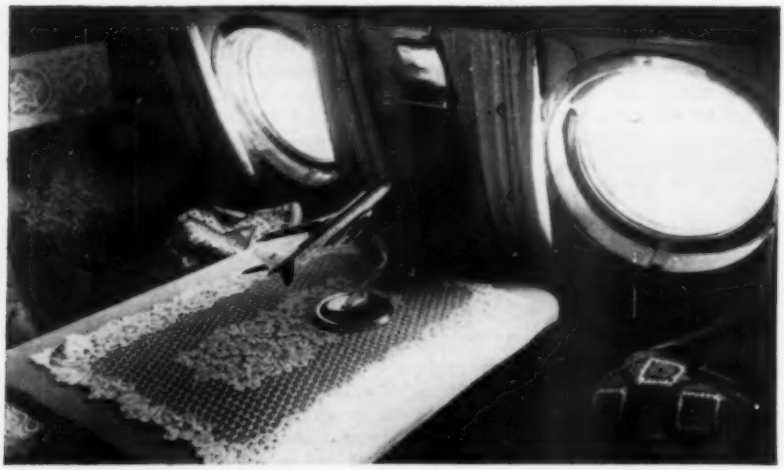
After scoring a clear propaganda beat with the Western appearance of their Tupolev 104 jet transport (AW April 2, p. 28), the Russian Communists demonstrated once again last week that, despite all their progressive engineering skill, they still cling to at least a few of the burgeois trappings typical of their Czarist ancestors.

A VIP compartment (below) has been plushly equipped with damask-backed, Pullman-type seats decorated with crocheted doilies that have the Red Star as their centerpiece and an intricately-worked crochet tablecloth. Additional standard VIP equipment seems to be garish seat pillows.

The cockpit layout (above) presents a different story and bears a striking similarity to the compartment of Boeing's B-29. The instrument panel of the cockpit, which probably is the same as that of the Badger, follows the conventional pattern with flight instruments on either side of the engine controls which are grouped in the center between the pilot and co-pilot. Visible portion of co-pilot's instrument panel indicates that the jet transport is equipped with ILS. The controls themselves also are conventional, with the mike button located on the yoke.

Cockpit visibility appears to be average.

The picture at the right showing the Tu-104's passenger compartment again underscores the Russian fondness for fittings that are less than modern. Note the old-style overhead lights and the "sea-net" baggage racks. Individual oxygen masks do not, despite some reports, indicate that the Tupolev cabin is not pressurized. Similar, but probably more advanced, equipment is planned for American jet airliners for emergency use in the event of high-altitude de-pressurization. Boeing is working on plans for its 707 jet transport incorporating an overhead system that would automatically swing into position immediately in front of the passenger's face in the event of such an emergency.



PLUSHY VIP COMPARTMENT smacks of Czarist era with damask, crochet fittings.

in nose compartment). Composite from two negatives accounts for the break in detail at left center.

. . . **ANTIQUATED DECOR** also prevails in passenger compartment. Individual oxygen masks do not mean that cabin is non-pressurized.

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Mackey Planning New Routes, Merger

Expansion is the key to the future plans of Mackey Airlines. The rapidly growing Florida-Nassau carrier has charted a program which includes extensive broadening of its route structure and introduction of new types of equipment.

The route program got a boost early this month when a Civil Aeronautics Board examiner recommended a new Florida - Havana - Nassau route for Mackey, as well as new stops at three points in the Bahamas. He also recommended that Mackey's certificate be renewed for three years.

A further expansion of Mackey's system is in the works through a merger with Midet Airlines. Mackey has contracted to buy Midet's route and assets, subject to CAB and White House approval, and a final agreement is currently being negotiated.

It would give Mackey a route between Palm Beach and Miami and Grand Bahama Island.

Mackey improved service on its present routes in February with the introduction of DC-4 equipment. Late last year, the carrier provided for future modernization of its fleet when it ordered two F-27 Friendships from Fairchild Airplane and Engine Corp. and optioned two more.

Proposed Route Additions

The new routes proposed for Mackey were approved by Examiner Curtis C. Henderson in his report on the Mackey Airlines Certificate Renewal Case. The carrier's original three-year authorization came before the CAB for renewal last year.

Henderson found that Mackey has done a good job of developing its new service and should have a three-year extension of its authority.

The present Mackey certificate calls for service between co-terminals Tampa and St. Petersburg and the terminal Nassau, British West Indies, via West Palm Beach and Ft. Lauderdale. The report advises the CAB to add Bimini, Great Abaco Island and Eleuthera Island, B.W.I., to this route and to authorize a new route between West Palm Beach-Palm Beach and Ft. Lauderdale, Havana and Nassau.

Rejecting National Airlines' and Eastern Air Lines' applications for the Bahamas routes, the examiner said the services needed in the area are best supplied by an aggressive shorthaul carrier like Mackey, rather than a larger trunk airline.

In recommending Mackey for renewal, Henderson found no reason to authorize it to carry mail on its routes, especially since the Post Office Department found no need for the added service.

A review of Mackey's three years of operation shows a record of substantial growth since service started in January, 1953. Passenger traffic totaled 15,592 in 1953, rose to 22,016 in 1954 and 32,683 last year. Traffic increased roughly 50% each year.

The record is just as good this year with 8,611 passengers carried in January and February, compared to 6,077 in the same two months last year. Traffic from Tampa and St. Petersburg more than doubled in the same period, improving on a disappointing record for the two cities during the first year of operation.

Triangular Route Plan

The triangular route between Florida, Havana and Nassau is a key factor in Mackey's future plans. The carrier told the CAB that such a service would just about double its present traffic, since the Havana air route is heavily traveled. With such a route, Mackey would be the only airline carrying passengers between Havana and Nassau. Right now, travelers have to pass through Florida in flying between the two points.

The triangle route is considered a good prospect for tour sales, and Mackey proposes to promote it heavily, as it has the Nassau service. Permission for an American carrier to fly between Havana and Nassau was obtained recently in negotiations with the British government.

The three new island points suggested for Mackey have a less substantial potential, but they are part of a rapidly developing Bahaman resort area, and Mackey wants to be a part of the development effort.

Mackey didn't do as well in the New York-Nassau Case as it did in its certificate renewal case. In the New York-Nassau proceeding, the examiner advised the Board to name Pan American World Airways the American carrier for the route in preference to Mackey. He felt the long-haul service would be too much for Mackey to handle, but Mackey still hopes to get the nod when the CAB finally decides the case.

Mackey started service with four-engine equipment in February with one of two DC-4s purchased from Capital Airlines. The second DC-4 isn't needed for the airline's present route system so it has been leased back to Capital. It will be available to serve the Havana route if Mackey gets it.

The backbone of the Florida carrier's operation has been a fleet of four DC-3s. With the arrival of the DC-4, a DC-3 was released from service, and it has been leased to Midet Airlines.

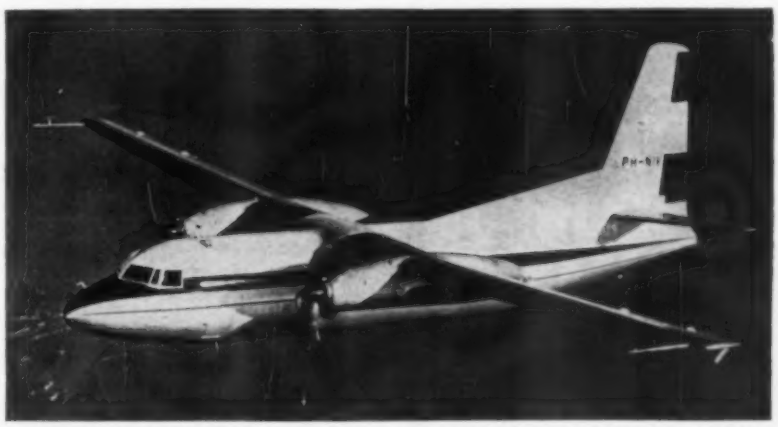
F-27's Advantages

Mackey was the first airline to give Fairchild a firm order for the F-27. Fairchild is currently gathering other orders and has promised Mackey delivery in October and November, 1957, if plans to manufacture the turboprop transport are completed.

The choice of the F-27 was made because the plane fits Mackey's routes, Vice President Len Povey told AVIATION WEEK.

Another prospect was the Vickers Viscount, now operated to Nassau by British Overseas Airways Corp. Povey points out that on Mackey's short routes the extra speed of the Viscount has little meaning, and the British airplane costs more—Mackey can buy two F-27s for the price of one Viscount.

Povey also points out that the F-27 will haul 40 passengers with two engines while the Viscount takes four engines, and higher costs, to do the same job.



LOOKING TO FUTURE, Mackey was first to give Fairchild firm order for F-27 Friendship.

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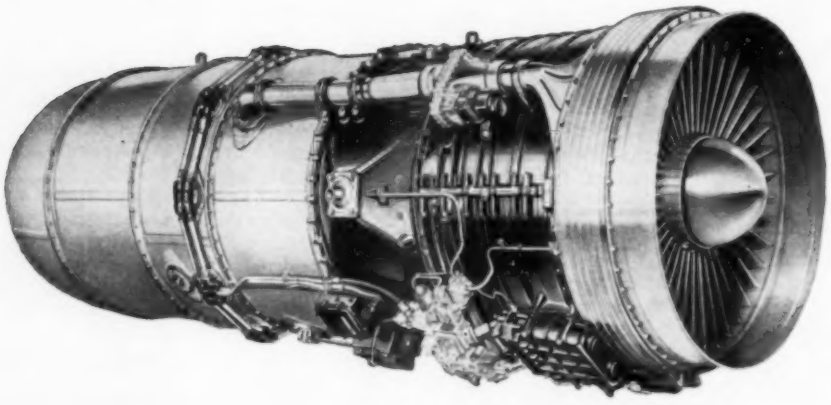

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Full CAB Probe of Airline Fares Is Urged in Report to Congress

Washington—The General Accounting Office urges in a report to Congress that Civil Acronautics Board institute a full-scale investigation of present airline fares.

In 1952, such an investigation was voted down 3 to 2 by CAB, when member Harmar Denny switched his position—an action which has been the subject of recent hearings before the House Judiciary Subcommittee headed by Rep. Emanuel Celler (D.-N. Y.). Air Transport Assn. vigorously opposed the investigation, which was expected to lead to a reduction in fares.

"The Board has spent much time and effort investigating the airmail and freight revenues which amount to only 15% of the total airline revenues," GAO observed. "But the Board has never made a general investigation of passenger fare revenues which, since 1938, have amounted to more than 80% of all revenues received by the domestic certificated carriers." GAO said there is "serious doubt" that CAB should have granted an increase four years ago of $1 for each one-way ticket when the trunk lines were "enjoying high rates of return."

The GAO report made numerous recommendations for new legislation, as well as Board actions.

The legislative recommendations included:

- **Establish a definite** policy on the duration of subsidy to air transportation.
- **Provide for a** complete separation of subsidy from service mail pay and make all carriers—not just those holding mail certificates—eligible for subsidy, and establish a contract method for subsidy with provision for recapture of excess profits.
- **Direct the Department** of Defense to transfer, wherever possible, military mail, cargo and passengers to certificated carriers and require government employes travelling overseas to go by U. S. airlines.
- **Grant the Board** specific authority to establish depreciation rates for carriers, a power which other regulatory agencies already have.
- **Authorize the Board** to impose civil penalties for economic violations (CAB has urged this for several years but—in the face of opposition from both scheduled and non-scheduled carriers—Congress never has approved such authority for the Board).
- **Give the Board** "the unquestioned right" to audit the books and records of the domestic affiliates and associates of air carriers, authority to limit salaries of executives for allowance in determining subsidy.

GAO urged the CAB to:

- **Institute a** full-scale and continuing program of evaluation of the route pattern.
- **Gear service** mail rates to air freight rates.
- **Require annual** audits of certificated air carriers by independent public accountants.
- **Adopt a "more** demonstrative position" regarding accounting and reporting regulations, and institute "prompt action" to strengthen the CAB's air carrier audit activity.

GE's CJ805 Engine Raises Skylark Speed

Los Angeles—Convair's Skylark 600 jet transport will have a design cruise speed of 609 mph. at 35,000 ft., made possible by engine thrust increase over the original 10,000 lb. on which the former cruise speed figure of 580 mph. was calculated.

New powerplant will be the General Electric CJ805 turbojet, commercial version of the J79.

The Air Force has released it for use in the plane.

General Electric says that the CJ805 will produce more thrust per pound of engine weight than any other engine in its power class.

Direct operating costs of the medium-range airliner, based on a first class configuration of 80 passengers, will range between 1.4 and 1.7 cents per seat-mile, for 1,500-mi. and 500 mi., respectively.

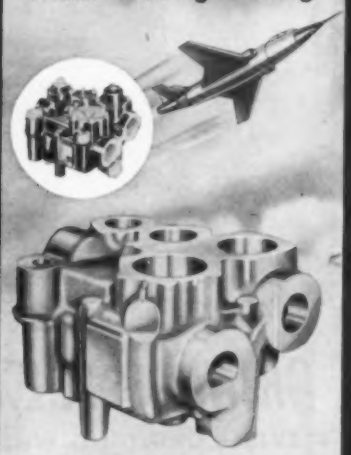
This is attributed in part to the high block speeds the plane will be able to achieve because of its high cruise speed and quick climb.

For 500-mi. trip lengths, the Skylark will have a block speed of 413 mph., Convair claims. On a 1,000 mi. trip, block speed will be 470 mph., while on a 1,500 mi. trip, it will be 504 mph.

With a medium-range gross takeoff weight of slightly over 150,000 lb., the plane will be able to lift itself off the ground after a run of 4,000 ft. at Chicago, fly the 1,751 mi. to Los Angeles at 35,000 ft. against a 50-mph. headwind, Convair says, and still have fuel to fly 200 mi. at 25,000 ft. and hold above the alternate airport at 15,000 ft. for one hour.

Passenger cabin will be maintained at the 8,000-ft. pressure level when the Skylark 600 is flying as high as 40,000 ft.

Chandler-Evans depends on **HAMPDEN BRASS** for Main Housing Casting



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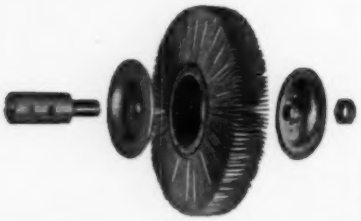

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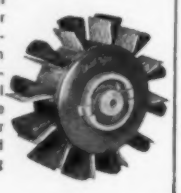

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ACC Reveals National Search & Rescue Plan

Washington—A National Search and Rescue Plan has been developed by the Air Coordinating Committee to set up rules and areas of responsibility among Federal agencies doing search and rescue (SAR) work.

It implements President Eisenhower's Civil Air Policy of May, 1954, which proposed a plan for making more efficient use of SAR facilities.

The National Search and Rescue Plan establishes three SAR regions. The Treasury Department, Defense Department, Commerce Department, Civil Aeronautics Board and the Federal Communications Commission—all of which are involved in SAR work—endorsed the plan.

The inland region, to be coordinated by the Air Force, includes the continental United States. The Coast Guard has responsibility for the maritime region, which includes most of the North Pacific Ocean and part of the North Atlantic.

Overseas regions are to be coordinated by the overseas unified command in each area. The plan covers only the activities of Federal agencies and is not mandatory for local organizations.

The agency responsible in each region will negotiate agreements with other agencies, designed to make the most efficient use possible of available search and rescue facilities. Agreements may also provide for cooperation with state and local organizations.

The ACC sets a deadline of July 1, 1956 for negotiation of agreements among the agencies covered by the plan.

CAB Orders

(Mar. 29-April 4)

GRANTED:

Seaboard and Western Airlines an exemption to perform a charter flight from Madrid to New York, Boston, Philadelphia or Baltimore pursuant to a contract with Phs. Van Ommeren, agents for Ocean Trading Corp.

Eastern Air Lines and Piedmont Airlines exemption authority to operate the routes granted them in the Charleston-Columbus case while the CAB complies with a recent court decision on the case.

Midet Aviation Corp. an exemption to lease one DC-3 from Mackey Airlines.

Trans-Pacific Airlines an exemption to lease one C-47 aircraft from Joel H. Carroll for a period of 45 months.

Leave to intervene in the Phoenix Service Case to City of Flagstaff, City of Prescott and the Prescott Chamber of Commerce, City of Pueblo and the Pueblo Chamber of Commerce. Colorado Springs Chamber of Commerce was denied leave to intervene.

Capital Airlines an exemption to provide free transportation to seven technical representatives of Vickers-Armstrongs, Ltd. and six technical representatives of Rolls-Royce, Ltd. in connection with Capital's use of the Viscount, for six months.

Capital Airlines an exemption to provide free transportation to two technical representatives of Rotol Ltd. for inflight observation, for six months.

APPROVED:

Agreement between Aerovias Sud Americana and Riddle Airlines for reciprocal charter of C-46 cargo aircraft with crews for periods not to exceed five days.

Frontier Airlines' change in service pattern which permits the carrier to overfly Pueblo, Colo., on Segment 3 on all flights in excess of one daily roundtrip.

New York Airways' flight pattern revision which adds White Plains as a stop on one one-way flight between Stamford, Conn., and LaGuardia Airport.

Agreements involving Trans World Airlines, American Airlines and various other carriers relating to intercarrier arrangements.

ORDERED:

Northern Consolidated Airlines to show cause why the Board should not set final mail rates of 164.74 cents per mile from Feb. 3, 1956 to Apr. 30, 1956; 93.30 cents from May 1, 1956 to Oct. 31, 1956 and the like six month period in each succeeding year; and 164.74 cents from Nov. 1, 1956 to Apr. 30, 1957 and the like six month period in each succeeding year.

Alaska Airlines to show cause why the Board should not set temporary mail rates at the level of reported break-even need while the Board is determining final rates.

CAB order approving International Air Transport Assn. resolutions clarified on the status of approval of certain tourist service and mixed class service resolutions.

Roland F. Beers, Inc.'s authority to conduct airborne geophysical surveys extended to Apr. 21, 1956.

Caribbean-Atlantic Airlines' final mail rate set at the rate proposed by the Board in its show cause order for the period starting July 1, 1955.

Suspension of the proposal of Trans Caribbean Airways to provide free ground transportation and an additional baggage allowance extended to July 8, 1956 to allow added time for investigation.

DISMISSED:

Riddle Airlines' application to lease one C-46, since application has been withdrawn.

Trans World Airlines' application for exemption authority to make a traffic stop at Dublin on one New York-London flight, since the application has been withdrawn.

DENIED:

Petition of Allegheny Airlines and 12 other airlines for leave to intervene in the Large Irregular Air Carrier Investigation.

North American Airlines' petition for reconsideration of CAB action denying the carrier exemption authority to operate a transatlantic coach service.

Motions filed by Intra-Mar Shipping Corp., Intra-Mar Agency, Inc., Intra-Mar Transport Corp., Intra-Mar Shipping, Ltd., Ernest R. Binder, Ernest Seiler and Southern Air Transport for dismissal of an enforcement proceeding and for other relief.

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P-1313, Aviation Week
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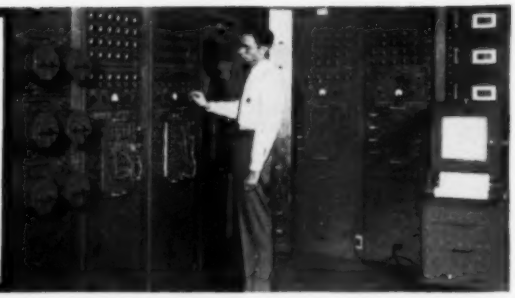

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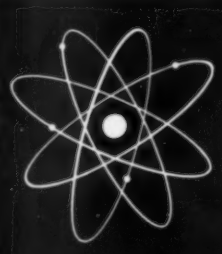

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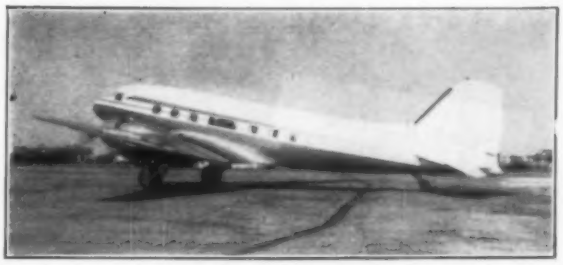

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK—APRIL 16, 1956

AEROTEST LABORATORIES, INC. 57
Agency—Richmond Adv. Service, Inc.
AEROTHERM CORPORATION, THE 82
Agency—Heintz & Company, Inc.
AIRBORNE ACCESSORIES CORP. 39
Agency—Gray & Rogers Adv.
AIRCRAFT EQUIPMENT TESTING COMPANY 45
Agency—Mallord Advertising, Inc.
AIRWORK CORPORATION 49
Agency—Gene Wyble Advertising
AMERICAN MACHINE & FOUNDRY COMPANY 109
Agency—Fletcher D. Richards, Inc.
AMERICAN PHENOLIC CORP. 78
Agency—Burton Browne Adv.
AMERICAN SEATING COMPANY 66
Agency—Brooke, Smith, French & Dorrance, Inc.
ARROWHEAD RUBBER CO., DIV. OF NATIONAL MOTOR BEARING CO., INC. 116
Agency—Dan Ehlerts Adv.
AUSTENAL LABORATORIES, INC. (MICROCAST DIVISION) 6
Agency—Gaynor, Colman, Prentis & Varley, Inc.
AVIATION WEEK 68, 69

B & H INSTRUMENT CO., INC. 97
Agency—The Kozula Company
BARBER-COLMAN CO. 72
Agency—Howard H. Monk & Associates, Inc.
BELL AIRCRAFT CORP. 108
Agency—Comstock & Co.
BUCKEYE IRON & BRASS WORKS, INC. 115
Agency—Kircher, Helton & Collett, Inc.

CANADAIR, LTD. 92
Agency—Walsh Advertising Co., Ltd.
CARMA MANUFACTURING CO. 61
Agency—Franklin Associates
CELCO-CONSTANTINE ENGINEERING LABORATORIES CO. 56
Agency—John Phillips Adv. Co.
CENTURY CONTROLS CORP. 85
Agency—C. M. Johnson & Associates, Inc.
CLARY CORPORATION (AUTOMATIC CONTROLS DIV.) 84
Agency—Erwin, Wasey & Company Ltd.
CLEVELAND PNEUMATIC TOOL COMPANY 15
Agency—Meldrum & Fewsmith, Inc.
CONNECTICUT HARD RUBBER COMPANY 42, 43
Agency—Todaro, Inc.

DOUGLAS AIRCRAFT CO., INC. 106
Agency—J. Walter Thompson Co.
DOW CORNING CORPORATION 102
Agency—Church & Guisewite, Adv.

EASTMAN KODAK CO. (X-RAY DIV.) 58
Agency—J. Walter Thompson Co.
ESSO EXPORT CORPORATION 40
Agency—McCann-Erickson, Inc.
EX-CELL-O CORPORATION 5
Agency—Holden-Chapin-Larue, Inc.

FAIRCHILD ENGINE & AIRPLANE CORP. 35
Agency—Gaynor, Colman, Prentis & Varley, Inc.
FARNSWORTH ELECTRONICS CO. A DIV. OF INTERNATIONAL TELEPHONE & TELEGRAPH CORP. 82
Agency—Chamberlin-Junk Adv., Inc.
FINN & CO., T. R., ELECTRONICS DIV. 95
Agency—Feeley Advertising Agency
FLIGHT RESEARCH, INC. 59
Agency—D. C. Smith, Inc.

GABB SPECIAL PRODUCTS 99
Agency—Charles Palm & Co.
GARRETT CORP., AIRESEARCH MFG. DIV. 20
Agency—J. Walter Thompson Co.
GENERAL ELECTRIC COMPANY 24, 67, 80
Agency—G. M. Basford Company
GENERAL ELECTRIC CO. (LIGHT MILITARY ELECTRONIC EQUIP. DEPT.) 54
Agency—Deutsch & Shea, Incorporated
GENERAL ELECTRIC CO., TUBE DIV. 3
Agency—Maxon, Inc. Adv.
GENERAL LABORATORY ASSOCIATES, INC. 89
Agency—Riger & Sheehy, Adv.
GENERAL MILLS, INC. (MECHANICAL DIV.) 120
Agency—Batten, Barton, Durstine & Osborn, Inc.
GOODYEAR TIRE & RUBBER CO., INC. 3
Agency—Kudner Agency, Inc.
GULF OIL CORPORATION 128
Agency—Young & Rubicam, Inc.

HAMPDEN BRASS & ALUMINUM CO. 131
Agency—Arthur Musen Associates
HAYES AIRCRAFT CORPORATION 147
Agency—Silver & Deutsch Co., Inc.
HARTWELL AVIATION SUPPLY CO. 81
Agency—The McCarty Company
HARTZELL PROPELLER, INC. 99
Agency—The Jas H. Maish Co.
HELI-COIL CORPORATION 41
Agency—G. S. Tyson & Co., Inc.
HEXCEL PRODUCTS, INC. 98
Agency—Charles P. Johnson Co.
HYDRO-AIRE, INC. 114
Agency—Byron H. Brown & Staff

JOY MANUFACTURING COMPANY 42
Agency—W. S. Walker Adv. Inc.

KELSEY-HAYES WHEEL CO. 36
Agency—Zimmer, Keller & Calvert, Inc.
KOLLSMAN INSTRUMENT CORP. 13
Agency—Schaefer & Favre Adv.

LAVELLE AIRCRAFT CORP. 73
Agency—The Roland G. E. Ullman Organization
LEACH CORPORATION (INET-PALMER DIV.) ..... Third Cover
Agency—The McCarty Company
LEAR, INC. 37, 38
Agency—Buchanan & Co., Inc.
LE TOURNEAU, INC., RG. 117
Agency—Evans & Associates
LEWIS ENGINEERING COMPANY, THE 99
LIBRASCOPE, INCORPORATED 18
Agency—Western Advertising Agency, Inc.

LOCKHEED AIRCRAFT CORP. 88
Agency—Foote, Cone & Belding
LOCKHEED AIRCRAFT CORP. 96
Agency—Hal Stebbins, Inc.
LOCKHEED AIRCRAFT CORP. 118
Agency—Donahue & Co., Inc.

MANNING, MAXWELL & MOORE, INC. (AIRCRAFT PRODUCTS DIV.) 10
Agency—Fuller & Smith & Ross, Inc.
MARLIN ROCKWELL CORP. 83
Agency—Griffith & Rowland Adv.
MARQUARDT AIRCRAFT COMPANY 107
Agency—Heintz & Co., Inc.
McDONNELL AIRCRAFT CORP. 86
MERIT PRODUCTS, INC. 132
Agency—Dozier Eastman & Co.
MINNEAPOLIS-HONEYWELL REGULATOR CO. (AERONAUTICAL DIV.) 11
Agency—Foote, Cone & Belding
MOOG VALVE CO., INC. 57
Agency—Warman, Robins & Gorham, INC.

NATIONAL WATER LIFT CO. DIV. OF CLEVELAND PNEUMATIC TOOL CO. 9
Agency—E. L. Erickson & Associates
NORDEN-KETAY CORP. (INSTRUMENT & SYSTEMS DIV.) 27
Agency—Hicks & Greist, Inc.
NORTH AMERICAN AVIATION, INC. 112
Agency—Batten, Barton, Durstine & Osborn, Inc.

OLIN MATHIESON CHEMICAL CORP. 104, 105
Agency—Doyle, Kitchen & McCormick, Inc.

PACKARD ELECTRIC DIV., GENERAL MOTORS CORP. 15
Agency—J. Campbell-Ewald Co.
PIONEER CENTRAL DIV. OF BENDIX AVIATION CORP. 76
Agency—MacManus, John & Adams, Inc.

RAYTHEON MFG. CO. 17
Agency—Donahue & Coe, Inc.
REACTION MOTORS, INC. 74, 75
Agency—J. Wheelock Associates
RED BANK DIV., BENDIX AVIATION CORP. 88
Agency—MacManus, John & Adams, Inc.
REEVES INSTRUMENT CORP. 44
Agency—The Edward W. Robotham Co.
ROBINSON CO., RALPH C. 61
Agency—Chapin-Dunne Adv.
ROHR AIRCRAFT CORPORATION 91, 94
Agency—Barnes Chase Co.
ROLLS-ROYCE LTD. 130
Agency—The Wesley Associates
RYAN AERONAUTICAL COMPANY 14
Agency—Batten, Barton, Durstine & Osborn, Inc.

SANBORN COMPANY 101
Agency—Meissner & Culver, Inc.
SCOVILL MANUFACTURING CO (AIRCRAFT FASTENER DIV.) 119
Agency—Needham, Louis & Brorby, Inc.
SEARCHLIGHT SECTION 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146
SENSENICH CORP. 80
Agency—Foltz-Wessinger, Inc.
SERVICE STEEL DIV., VAN PELT CORP. 121
Agency—Claude E. Whipple Adv.
SERVO CORPORATION OF AMERICA 64
Agency—D. C. Smith, Inc.
SERVOMECHANISMS, INC. ..... Fourth Cover
Agency—Sanger-Funnell, Inc.
SHELL CHEMICAL CORPORATION (CHEMICAL SALES DIV.) 7
Agency—J. Walter Thompson Co.
SIKORSKY AIRCRAFT DIV., UNITED AIRCRAFT CORP. 110, 111
Agency—Lennen & Newell, Inc.
STACKPOLE CARBON COMPANY 121
Agency—The Harry P. Bridge Co.
STROUKOFF AIRCRAFT CORP. 52
Agency—J. Wheelock Associates
SUNDSTRAND MACHINE & TOOL CO (AVIATION DIV.) ..... Second Cover
Agency—Howard H. Monk & Associates, Inc.
SUTORBILT CORPORATION 61
SYLVANIA ELECTRIC PRODUCTS, INC. 65
Agency—J. Walter Thompson Co.

THERMO ELECTRIC CO., INC. 79
Agency—Fred Lange Assoc., Inc.
TITEFLEX, INC. (AVIATION PRODUCTS DIV.) 70, 71
Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc.

UNITED AIRCRAFT CORPORATION 113
Agency—G. F. Sweet & Co., Inc.

WALL COLMONY CORP., STAINLES PROCESSING DIV. 85
Agency—A. Hemsing Advertising
WEATHERHEAD COMPANY THE (AVIATION DIV.) 8
Agency—Chamberlin-Junic Adv. Inc.
WEBER AIRCRAFT CORP. 4
Agency—Charles Bowes Advertising, Inc.
WESTERN AIRLINES, INC. 124
Agency—Buchanan & Company, Inc.
WESTINGHOUSE ELECTRIC CORP. (STURTEVANT DIV.) 87
Agency—Fuller & Smith & Ross, Inc.
WHITTAKER GYRO, DIV. OF TELECOMPUTING CORP. 90
Agency—Mogge-Privett, Inc.
WYMAN GORDON CO. 22
Agency—John W. Odlin Co., Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 133-143
SPECIAL SERVICES TO THE INDUSTRY 146
PLANES—EQUIPMENT (Used or Surplus New) For Sale 143-146
WANTED Planes—Equipment 143

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I saw the excellent reproduction of our visualized flow research work in your March 19 issue. I very much appreciate your interest in our work.

There was, however, an omission in the text accompanying the pictures, in that there was no mention made of those who have made our work possible. The program is sponsored by the Air Branch of the Office of Naval Research.

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On Dead Weight

Every military jet today drags along 10 to 15 pounds of absolutely dead weight. This weight is found in the heavy-gage vibration mounting bases for each piece of electronic gear.

When one pound of weight saved on a plane is worth $500, this seems like a staggering penalty to pay for dead weight.

According to an investigation by our engineers who have been designing lightweight bases since 1947, 15% to 28% of the weight can be saved, as well as from $5,000 to $7,500.

Leading vibration engineers among the airframe builders and top project engineers in government support these findings. Yet the jets continue to carry dead weight. Why?

Simply because of the outdated drawings on the military spec covering vibration mounts and mounting bases. This spec is purely a performance spec with no attention to weight. If a base were made of lead it could be used, provided it tested out.

To top this off, electronic manufacturers who purchase mounting bases must work on low bids. To keep their price low, they take the most economical base. For example, if three bases all meet the spec, one steel at $10 and one at $12 and a lightweight base at $13, they take the $10 steel base. And the plane suffers. (Lightweight bases as a rule cost more than steel because of the extra tooling required.)

On the other hand, airframe makers have prime responsibility for the aircraft's performance. Extremely weight conscious, they are being forced by these outdated drawings into odd courses of action.

They are requesting that they be allowed to purchase lightweight bases which meet the spec. They are beginning to write their own specs for electronic gear vibration mounts and mounting bases. This latter would be chaotic to standards already set up for mass production in an emergency.

What, then, can be done? One partial solution is to revise the drawings on the specs. They should set the weight limitation at the *minimum* as provided by the vibration industry. Minimum weight limitations could save as much as 50% of the weight on a stainless steel base in wide use today. This base, for example, weighs six pounds. The same design in lightweight metal weighs only three pounds, and still meets the required spec. This is only one base; there are many others.

Another equally important point about vibration control equipment concerns electronic reliability. In this case, the military spec is relatively good. Nevertheless, it has a grave weakness.

It specifies the same base for all types of aircraft—jet, missile, helicopter and reciprocating engine. The time has gone when one base will stand up under all environmental vibration conditions. The natural frequency of each craft is different . . . yet the bases are the same. This plays havoc with electronic gear, piles up UR's and contributes to unreliability.

Here again the vibration industry has to go back to the specification for changes. A new overall MIL or JAN spec for vibration mounts and mounting bases should be written. It should be extended to apply to the environmental performance of each craft. A spec so written would help the entire vibration industry, as well as the government. It would also

a. increase standardization of mount and mounting base design;
b. provide the Industry with the freedom to meet present, and the initiative to meet future vibration problems in supersonic craft;
c. save countless costly hours in trial-and-error methods of securing performance data.

Once again, some solution to both problems—weight and unreliability—seems to rest with revisions in government drawings to use lightweight bases that are available; and revisions to the MIL or JAN spec to meet today's challenges, not yesterday's.

Robert W. Dugan
Project Engineer, Electronics Division
T. R. Finn & Company, Inc.
200 Central Avenue
Hawthorne, N. J.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Cleveland Helicopters

The February 27th issue of Aviation Week carried a review of CAB Examiner Joseph L. Fitzmaurice's recommended helicopter passenger service for Chicago.

The second paragraph headed "First Downtown Service" pointed out that it would be the *first* downtown helicopter service. Cleveland Air Taxi, Inc., has been operating a helicopter passenger service between Cleveland Hopkins Airport and Cleveland Lakefront Airport since October 20, 1954. Lakefront Airport is but five minutes from any downtown Cleveland area. In fact, at the present time, Cleveland Air Taxi is the only helicopter passenger service in operation between New York and Los Angeles.

Perhaps you were referring only to the two helicopter airlines having a Civil Aeronautics Board certificate of public convenience and necessity, but for the record, Cleveland Air Taxi, Inc. has five aircraft operating daily from Cleveland Hopkins Airport to downtown Lakefront Airport, a matter of minutes to the heart of the metropolitan area.

Doris S. Miller
Public Relations
Cleveland Air Taxi, Inc.
930 Hanna Building
Cleveland 15, Ohio

Controller's Burden

In a well-timed plea for the center controllers ("Three Cheers for the Controllers"), Capt. Robson highlights some aspects of the job conditions that would bear close scrutinizing in the current drive to modernize air traffic control.

There seems to be no disagreement that ATC centers continue to provide remarkable service under near-saturation conditions; that they are doing so with a system tailored to DC-3 performance is incredible.

In the meantime, a gradual process of erosion is taking place within the centers. The hard core of veteran controllers is breaking up. Promotion to supervisory positions accounts for part of the change, but valued career men are drifting away to more lucrative jobs at the same time. The vacated positions that were once snapped up are no longer as simple to fill; many a job in the larger centers now goes begging for lack of eligible bidders.

Candidates for the position of air traffic controller must serve an apprenticeship of from two to four years in a center before reaching the controller level. Faced with the terrific growth of traffic plus the steady deterioration of controller working conditions, the assistant-controller is likely to think twice about making a career of it, and when he considers the meager salary jump, may decide it is not worth the effort. Indeed, if he stays an assistant long enough, automatic pay increases cancel out any salary distinction between the two jobs. Characteristic of the system, salary structure is fixed by a 1949 reclassification act.

In some respects, it is fortunate that authorized overtime and six-day weeks with attendant pay benefits have become available to provide necessary coverage as the workload multiplies. Such measures are nonetheless dangerous in a business where safety is paramount.

Undoubtedly, vast changes are in store for the centers, with more radar, additional direct frequencies, better navigational fixes and a more reasonable use of air space. Unless some concrete recognition is given the human controller, however, in the form of job prestige, comfortable working quarters, realistic workloads and reduced noise level, the heralded new system may fall somewhat short of expectations.

Name Withheld

400 cycle power

for research, quality control, and pre-flight checkout

Accurate device *output* demands accurate power *input*, and in 400-cycle equipment—vital in today's aircraft and missiles—accuracy is everything. For the *precise* input power needed in designing, manufacturing and checking out of modern avionic systems, it's a growing habit to buy LEACH (INET-Palmer) 400-Cycle *Precise* Power...complete packages, ready to "plug-in."

Every LEACH (INET-Palmer) 400-cycle unit is designed *as a system*, with both rotating equipment and magnetic-amplifier controls developed under one, coordinated research, development and manufacturing program. The result . . . precision and dependability *beyond* what today's planes and missiles actually call for, operating characteristics ready for electrical and electronic demands still on the drawing boards.

There's a LEACH 400-cycle motor-generator set for virtually every application where regular line power must be changed to closely regulated, stable 400-cycle frequency. These standard models share the same high electrical performance standards . . . only the physical arrangements are varied for maximum utility . . .

FOR THE FLIGHT LINE . . . Completely portable, trailer-mounted sets . . . weatherproof, vibration-resistant, capable of traversing rough terrain without loss of accuracy . . . more than a match for the accuracy demanded by today's and tomorrow's avionic systems. Offered in ratings from 5 to 100 KW (3-phase).

FOR THE PLANT . . . Control elements in a floor-standing cabinet . . . motor and 400-cycle alternator rigidly dowelled to separate structural-steel base. Available in ratings from 50 to 100 KW (3-phase).

FOR THE LABORATORY . . Compact, single-cabinet units with all rotating equipment and controls on a single, rigid base which may be caster mounted or easily moved by fork-lift truck. Available 5 to 40 KW (3-phase).

STANDARD PERFORMANCE SPECIFICATIONS
. . . all models

Ratings.....3-phase: 5 to 125 KVA @ .8 P.F.
1-phase: 3 to 85 KVA @ .8 P.F.

Output Voltage...115/200 or 120/208, 3-phase, 4-wire
115 or 120, single phase

Input Voltage.....440 volts, 60 cps, 3-phase (220 or 220/440 optional)

Overload Rating.....125% for 3 minutes

Regulation:
Frequency...400 cps ±0 cps with 60 ± cps input
Voltage..... ±1% (±½% optional)

Recovery Time.....to 20 KVA — .150 sec.
20 to 50 KVA — .200 sec.
62.5 to 125 KVA — .250 sec.

Voltage Dip or Overshoot.....less than ¼%

Voltage Modulation.....less than ¼%

Frequency Modulation.....less than ¼%

Phase Balance.....±4% max. voltage deviation from the average with one-third rated current on one phase and no load on the other two.

Wave Form.....3% rms total harmonic content (2% optional)

Basic Design.....rotating field

Complete specifications are listed in Leach's new brochure on 400-cycle motor-generator sets. Send for your copy today.

LEACH CORPORATION / INET-PALMER DIVISION

4441 S. SANTA FE AVE., LOS ANGELES 58, CALIFORNIA

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Born in a roar of thunder

Over 25 different models of the Range Servo (all tailored to meet the specific requirements of a particular aircraft) have, to date, been assembled from a few basic units. In every case the amplification, power source, and modulation stages are the same components.

Servomechanisms' first sub-system—the Range Servo Analog Computer got its wings in one of Republic's famous Thundercraft—the Thunderjet F-84D. More than just a product—the Range Servo was the beginning of a whole new design philosophy... one of reducing a complicated "all in one" servo system into individual plug-in units mounted on a common chassis. Over the years, from the F-84D through the modern F-84F, this design philosophy of "building block" sub-systems has enabled us to continue to solve complex military equipment problems for Republic and for many other major airframe manufacturers.

To all of these airframe manufacturers, the chief advantage of the "building block" concept is reliability. These companies have proved by tests and by usage that Servomechanisms' functionally packaged plug-in units are rugged and easy to service. As aircraft complexities continue to increase, reliability becomes more and more important. By constantly improving the performance and reliability of our own sub-systems, we contribute to the paramount goal of the U. S. Air Force... that of insuring the overall effectiveness of the total Weapons System.

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A156